THE ENGINEER

Engineering, Marine and Welding Exhibition at Olympia

Descriptive Supplement

THE twentieth Engineering, Marine and Welding Exhibition, which this year incorporates the Foundry Trades Exhibition, was opened yesterday, September 1st, at Olympia, London, and will be open daily until Thursday, September 15th. At this exhibition, one of the largest of its kind in the world, some 500 manufacturers are showing representative examples of their products covering practically the whole field of the engineering industry. It might be expected that with so many specialised trade exhibitions now being held at regular intervals in this country there would be a falling off in the number of exhibitors. In fact, the opposite is the truth. There is every indication that the field embraced by this exhibition is steadily widening with the introduction of new industrial developments, processes and equipment. On the business side it is anticipated that the exhibition will, as in previous years, attract many buyers from overseas countries, whilst practically all the technical associations and institutions in this country have arranged special visits for their members. Although these institution visits are in some measure social occasions the members never fail to take the opportunity to inspect the newly developed plant and equipment of improved design always to be found by the discerning visitor.

Prime movers have always formed a prominent section of this exhibition and over the past twenty years or so it has been interesting to see how the oil engine has been developed for marine and industrial applications. Now with the increasing interest in diesel-electric and diesel locomotive traction it is evident from many of the stands that the oil engine manufacturers have not been slow in anticipating the demand for suitable equipment for this particular application where size and weight are of such importance. The exhibits show clearly the impressive number of types and sizes of oil engines for all applications now available in this country. The development of the gas turbine for industrial application has recently been spectacular and some interesting sets are shown. Looking at these sets the visitor, thinking back to the time not so many years since when the oil engine began to replace the reciprocating steam engine, is likely to wonder how long it may be before the gas turbine succeeds the oil engine in a number of applications. And where better will it be seen than at Engineering and Marine Exhibitions in future years? Notwithstanding the developments made in the oil engine and the future of the gas turbine, the steam engineering side of industry is still in a very healthy state, as is evident from the many exhibits and the developments directed to attaining greater economy and efficiency in steam plants. The nuclear power field has as yet been barely touched commercially, but nevertheless visitors who are interested in the subject will find representative concerns prepared to discuss projects.

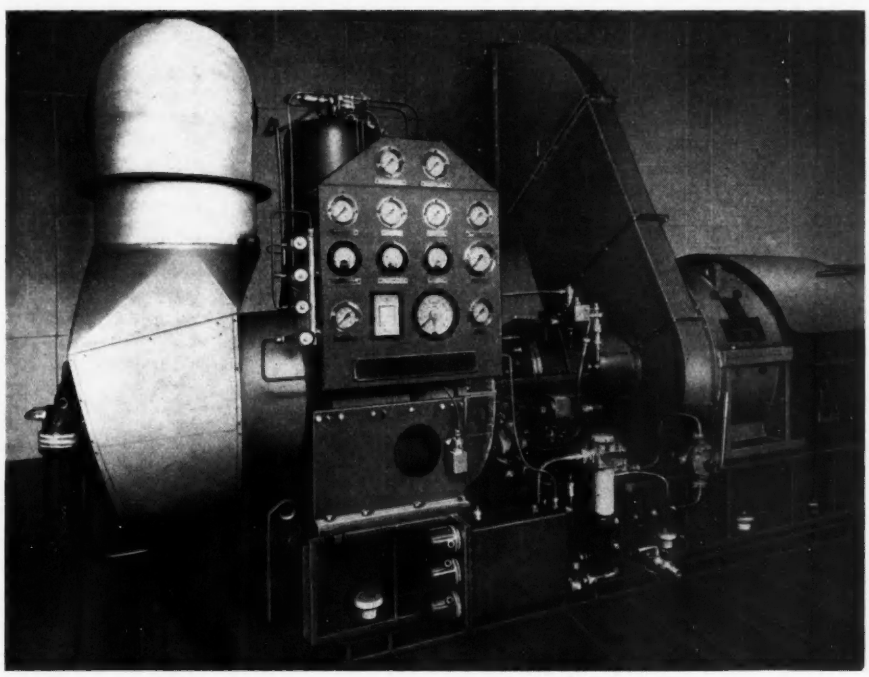

Fig. 1—350kW gas turbo-generator for marine emergency power supply—Allen

The welding equipment shown covers a very wide field of application, and many interesting demonstrations have been arranged to give some impression of the capabilities of this very valuable and versatile tool which has solved so many industrial and constructional problems in the past decade or two. The degree to which industry now depends upon welding is evident in the plant shown on practically every stand in the exhibition. The foundry has for long been regarded as the "black spot" in industry, but it will be evident from the plant shown in this section of the exhibition that mechanisation has been introduced to an extent which almost entirely eliminates the arduous side of the work, and the problem of air pollution has been seriously tackled. It is perhaps somewhat unfortunate that much of the new and efficient moulding plant is, perforce, put into old foundries, where dust and fumes continue to contaminate the atmosphere. The problem of economics must arise, but it is almost certain that the time is not far distant when the disinclination of labour to work under unpleasant conditions will make it necessary for firms to install this mechanised plant in new foundries where conditions will not detract from its cleanliness and efficiency.

In electrical engineering the more marked advances have been in electronics, particularly semi-conductors; on the "heavy current" side progress, solid but less spectacular, is to be found in numerous detailed improvements.

As will be appreciated, the wide field covered by the exhibits and their variety makes it impossible to give more than a general idea of the scope of the exhibition in this Supplement. For this reason we have selected from preliminary information, so far as is possible, a variety of equipment, engines and plant which is of new design, incorporates improvements, or has not been previously described in our columns. In subsequent issues we propose to deal with other exhibits.

W. H. Allen, Sons and Co., Ltd.

The main exhibit on the stand of W. H. Allen, Sons and Co., Ltd., Bedford, is a 350kW gas turbo-generator, one of eight similar sets being supplied for new ships under construction for Alfred Holt, Ltd. (Blue Funnel Line), and which are believed to be the first emergency gas turbo-generators to be installed in merchant vessels. In each of the eight ships concerned two 450kW diesel-engine-driven generators will be installed in the engine-rooms, while the gas turbine set will be housed in a

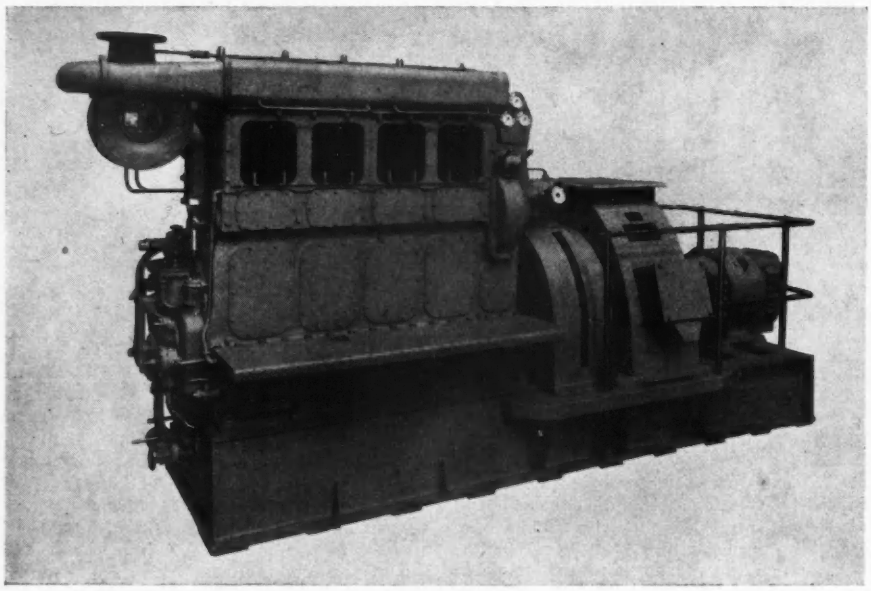

Fig. 2—150kW marine auxiliary diesel generating set—Allen

separate compartment on the upper deck. One of the gas turbo-generator sets is illustrated in Fig. 1. It comprises a single shaft, open cycle engine consisting of three main components—a single-stage centrifugal compressor, a reverse flow combustion chamber and a two-stage axial-flow turbine. The turbine drives both its own compressor, at a speed of 15,000 r.p.m., and one of the firm's d.c. generators through epicyclic reduction gearing at 1500 r.p.m.

For the gas turbine air is drawn into the compressor, which has a compression ratio of 2·7 : 1 and is then diffused into the annular air casing which completely envelops the turbine casing. From this casing the air passes into the casing surrounding the combustion chamber flame tube. The working temperatures of the flame tube and turbine casing are thus reduced. Some air enters the flame tube at the top via the swirler, where it mixes with the fuel atomised by the burner. The products of combustion are cooled to the designed working temperature by the excess air which enters the flame tube through dilution holes in the periphery of the flame tube. The gases are then discharged through the stator and turbine blading.

The single-stage, centrifugal compressor is of aluminium bronze (" Narrmac "), built in two sections. In it a compressor inducer, consisting of a number of curved vanes integral with a small diameter hub, mates up with the second section, which has radial vanes, to form the main compressor rotor.

The two-stage, axial-flow turbine has rotor blades of aerofoil section, each machined integral with its root and fitted in axial fir-tree slots in the periphery of the rotor wheels and then secured axially by a locking ring. The whole compressor and turbine-rotor assembly is clamped together by means of a manganese molybdenum bolt passing through the centrally-bored wheels.

The single reverse flow combustion chamber designed and made by J. Lucas (Gas Turbine Equipment), Ltd., is mounted vertically above the shaft, midway between the compressor and turbine rotors, and is fitted with a Lucas fuel-oil burner.

For starting purposes ignition of the fuel and air mixture is carried out by a high-energy surface discharge ignition unit, incorporating a torch igniter and operated on a 24V d.c. supply. The machine is designed for automatic starting in the event of a fall in voltage of the main electricity supply, and for hand starting in the compartment. The starting equipment consists of a Rotax multi-breech turbo-starter, powered by cordite cartridges. In the event of the turbine failing to start on the first cartridge, the second cartridge is arranged to fire automatically. The drive from the starting unit is through a star-type epicyclic speed-reduction gear and an automatic clutch fitted to an extension of the shaft at the exhaust end of the gas turbine.

The centrifugal speed governor is driven through bevel gearing from the reduction gear slow-speed shaft and arranged to control valves in the fuel-oil lines to and from the burner, via an oil relay. This relay is supplied with high-pressure oil from a valveless gear pump and is arranged so that, in the event of a failure of this oil supply, the machine is automatically shut down. Speed regulation may be carried out manually by means of a hand-wheel mounted directly on the governor casing. An overspeed governor is arranged to operate an emergency shut-off valve in the fuel system when the running speed exceeds the rated speed by 10–12½ per cent. It is also connected to the speed governor oil relay so that, in the event of failure of the oil pump drive, the resulting loss of governor oil pressure closes the valve, so shutting down the set. An electrical trip switch is arranged to trip the generator circuit breaker in the event of the emergency governor gear operating.

The turbine is equipped with four separate oil pumps, two being of the valveless gear type driven through bevel gearing from the reduction gear slow-speed shaft, the remaining two pumps, one of which is motor-driven and the other hand-operated, are auxiliary units, either of which can be used for priming the lubrication system before starting up and also for circulating oil through the system for cooling purposes when the set is shut down. A duplex cartridge pressure filter is fitted in the system and the oil is cooled in a radiator cooler fitted in the air intake to the compartment.

Heaters are incorporated in the fuel system to preheat the fuel to obtain the correct atomisation necessary for efficient combustion. The Lucas swashplate fuel pump is driven through bevel gearing from the reduction gear slow-speed shaft. The quantity of fuel delivered to the combustion chamber through the burner is varied by the opening of two throttle valves, one fitted in a by-pass from the supply pipe to the burner, and the other in the " spill " line, both valves being under the control of the speed governor. The control system incorporates an automatic device to prevent over-fuelling, which would result in too high a turbine inlet temperature during acceleration after initial light-up and during sudden load changes.

The turbine, gearing and generator, are all mounted on a fabricated combination baseplate, carried on resilient mountings. The section of the baseplate under the reduction gear serves as a lubricating oil tank.

The speed-reduction gear fitted is of the Allen-Stoeckicht, double-helical, planetary, single-reduction design and it reduces the turbine speed of 15,000 r.p.m. down to the generator speed of 1500 r.p.m., a ratio of 10 : 1.

The compound-wound 350kW d.c. generator is designed to run in parallel with the two 450kW diesel engine-driven generators which are also installed in the ship. This generator is mounted upon an extension of the turbine baseplate and has a single pedestal, white-metal-lined journal bearing which is forced lubricated from the turbine lubrication system. The bearing pedestal is insulated from the baseplate to eliminate shaft currents which might cause damage to the bearing surfaces.

The generating set exhibited (Fig. 2), is a 150kW marine auxiliary pressure-charged diesel engine-driven alternator set, with a four cylinder, 600 r.p.m., 270 b.h.p. engine, direct coupled to an alternator. This class of set is also constructed for power outputs of 75kW to 450kW (113 to 640 b.h.p.).

In this four-stroke airless injection, compression-ignition engine, the cylinder block is formed in a single casting secured to a deep-section bedplate. Ample inspection doors at the front and back of the crankcase

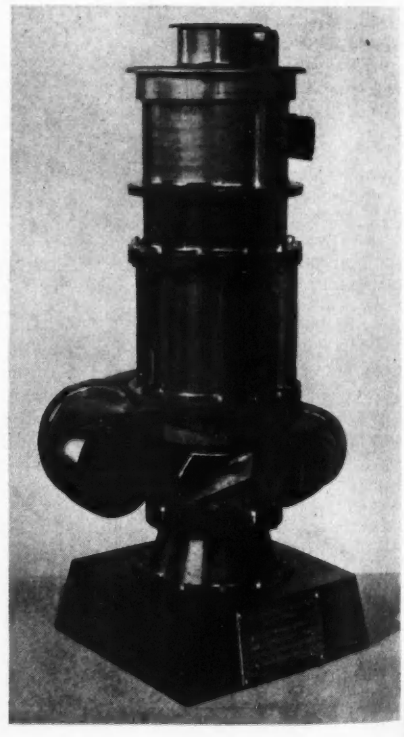

Fig. 3—Model of Allen-Stork vertical mixed-flow motor-driven pump—Allen

Fig. 4—Projection welding machine embodying twin transformers—Sciaky

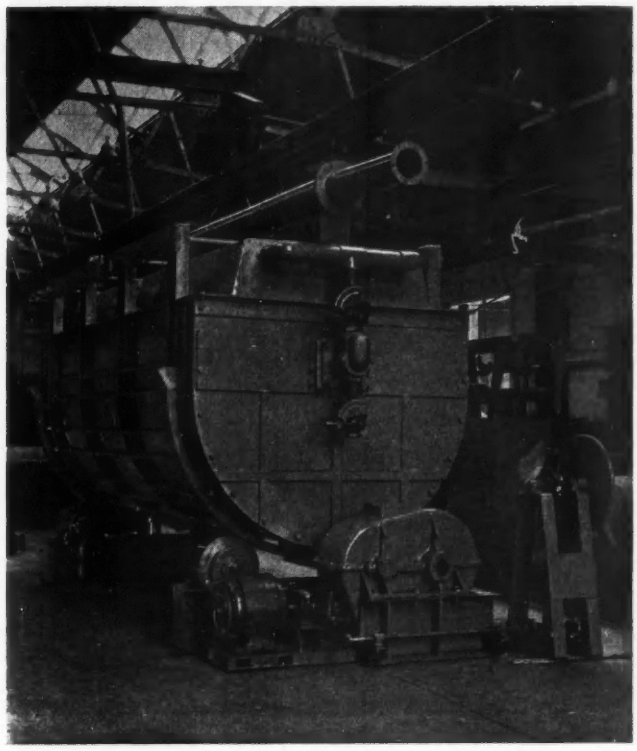

Fig. 5—Oil-fired hot metal receiver of 12 tons capacity—Monometer

give easy access to the main and connecting-rod bearings.

The materials used for all parts are specially selected for exacting marine service conditions. The inlet and exhaust valves, which are interchangeable, are actuated by short push-rods and rocking levers, each valve being provided with two springs, as well as a renewable seat made of special cast iron. A separate fuel pump is provided for each cylinder, each pump being close to its injector. This, together with the use of short interconnecting pipes, ensures an equal distribution of fuel to each cylinder at all loads. A centrifugal governor regulates automatically the fuel supply at all loads and its adjusting gear enables the engine speed to be varied while running. The camshaft is driven by a duplex roller chain from the crankshaft at the flywheel end.

The Allen alternator is of the ventilated, drip-proof, rotating-field, salient-pole type, running at the engine speed of 600 r.p.m. and having a full-load rating of 150kW, 214kVA, 0·7 power factor, three-phase, 60 c/s, 440V, with an overload capacity of 25 per cent for two hours.

The large vertical motor-driven pump exhibited is one of six Allen units being supplied to the London County Council for emergency sewage pumping duty. This pump is designed for an output of 13,440 gallons per minute against a total head of 35ft, and is directly-driven by a 200 b.h.p., three-phase, 50 c/s, 415/400V, slipring induction motor running at a speed of 730 r.p.m.

The pump, a model of which is shown in Fig. 3, which has a 26in diameter suction branch and a 24in diameter discharge branch is of the " Allen-Stork " mixed-flow design. It has a casing and impeller of cast iron, and a shaft of mild steel fitted with renewable gunmetal sleeves, the shaft being supported by two grease-lubricated ball and roller bearings. These bearings are housed in an external bracket which is mounted on the top of the pump. The pump shaft is flexibly connected to the motor driving shaft, the load due to the rotating parts of the pump being carried by the ball thrust bearing.

The motor is mounted on a pedestal secured to the top of the pump, the arrangement being very compact and giving ample space for inspection and/or dismantling. After removing the motor, it is possible to dismantle the pump by lifting the pedestal and top cover of the pump, and, at the same time, the shaft and impeller complete, leaving the pump casing in position and enabling the unit to be opened up for inspection without breaking pipe joints.

Sciaky Electric Welding Machines, Ltd.

Two characteristics of the PAD.100 heavy duty projection welding machine (Fig. 4) made by Sciaky Electric Welding Machines, Ltd., Slough, are its compact, symmetrical layout and ease of accessibility to the working area. Heavy conductors lead to each side of the 14in square tables of the machine and a transformer is housed on each side of the platens. This gives an even distribution of the current, which may reach 120,000A in the model of the machine exhibited, which is rated at 100kVA. Workpieces can pass right through the bridge frame, and this facilitates the use of the machine under production line conditions. The automatic welding cycle is initiated by push-buttons and timed electronically, and this arrangement provides for a post-weld forging operation. The force exerted on the upper platen by the 12in diameter air piston can go to 10,000 lb. Control of the welding current is by a Sciaky phase-shift, heat control unit with an ignitron contactor panel.

James Neill and Co. (Sheffield), Ltd.

Permanent magnets for use in many industrial applications and " Eclipse " magnetic tools, for use in all forms of work holding are being shown by James Neill and Co. (Sheffield), Ltd., Napier Street, Sheffield.

Of particular interest is a new size of permanent magnet chuck having a working area of 7in by 4in and an overall height of only $1\frac{11}{16}$in. This new model is particularly suited for use on small machines and in conjunction with the firm's 8in by 5in swivelling angle plate, provides a small swivelling chuck.

A circular chuck made by the firm and not previously exhibited is the 12in diameter heavy duty circular model. This chuck has been designed for use on large lathes, where heavy workpieces are handled and large cuts are made. Other magnetic aids to production exhibited include special magnetic tools for holding workpieces during welding and assembly operations. This display also includes a comprehensive range of permanent magnets of types incorporated by electrical and other manufacturers in their products. Typical applications represented are loud-speakers, television, telephones, electricity meters, measuring instruments, generators, motors and magnetos.

Monometer Manufacturing Co., Ltd.

A 12-ton hot metal receiver (Fig. 5) is displayed by the Monometer Manufacturing Co., Ltd., Savoy House, Strand, W.C.2. The metal is received from the cupola at about 2700 deg. Fah. and is kept hot by oil firing, gas can be used as an alternative fuel. Provision is made for preheating the combustion air by passing it through ducts in the flue. The receiver is lined with silica brick, and a lining life of nine months is expected in service. For pouring, the receiver is tilted by an electric motor under push-button control, or by a handwheel which is normally declutched. Where the cupolas are not able to pour into the receiver by launders, the receiver can be supplied with a bogie mounting ; intake of metal is not interrupted by tilting the receiver. This is the largest receiver made by the firm, which also displays other designs of melting furnaces for non-ferrous and ferrous metals.

John I. Thornycroft and Co., Ltd.

The marine diesel engines shown on one of the two stands of John I. Thornycroft and Co., Ltd., Thornycroft House, Smith Square, London, S.W.1, include the recently introduced 12½ to 16 b.h.p. "R.J.D.2" model illustrated in Fig. 6. This four-stroke, direct-injection engine has been designed for a variety of applications and is intended to meet a demand for a low-powered, medium-weight unit which is simple for unskilled persons to operate.

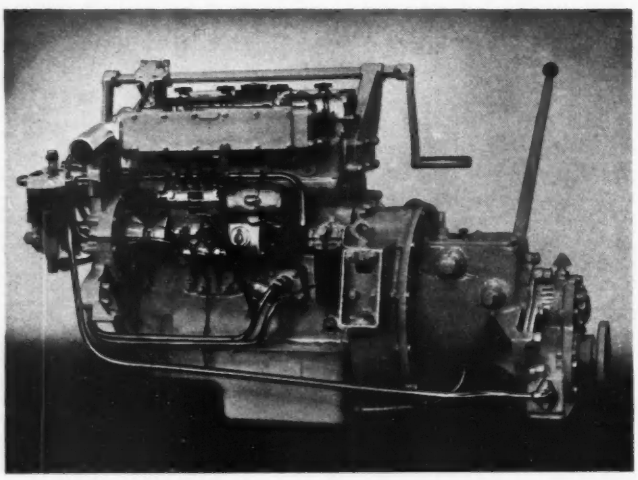

Fig. 6—Diesel marine engine developing 30 b.h.p. at 1750 r.p.m. and fitted with a manually operated reverse gear and 2 : 1 reducing gear—Thornycroft

The engine has a bore of 3⅜in and a stroke of 4⅛in, and develops a maximum output of 16 s.h.p. at 1800 r.p.m., or a heavy-duty output of 12½ s.h.p. at 1500 r.p.m. Its deep section cast iron crankcase incorporates the cylinder block, the bores of which are fitted with dry liners. The detachable cylinder head carries the valves and valve gear operated by short push rods from a single camshaft arranged high up in the crankcase and driven by spur gear from the crankshaft. A cast aluminium air inlet manifold carries an air silencer and the exhaust manifold is cast in the cylinder head.

The combustion chamber is formed in the crown of each aluminium alloy piston and the design is stated to give good starting from cold without the use of heater plugs or other aids. A C.A.V. pump is fitted and the injectors are of multi-hole design. The amount of fuel delivered is manually controlled in conjunction with a governor which runs at one and a half times engine speed and gives close control at both high and low speeds. The fuel feed pump is fitted with a hand-operated priming plunger.

The engine is lubricated by a pressure feed system through a plunger pump set low in the crankcase. A closed-circuit fresh water cooling system incorporates an external heat exchanger, the water being circulated by a large-capacity centrifugal pump. The standard engine has a dry exhaust with a water-jacketed exhaust silencer, but, if required, a water-cooled exhaust system can be fitted. The engine is fitted with an integral layshaft reverse-reducing gear, in which there are hand-lever controlled, large-diameter, expanding clutches for both ahead and astern drive. This gear gives a reduction of about 2 to 1, either ahead or astern, and its lubricating system is common with that of the engine.

The new engine is well adapted for industrial use and in one application which is demonstrated it is driving a distilling plant made by Buckley and Taylor, Ltd., of Oldham. This plant is used for the production of drinking water from sea water, although it may also be used for purifying stagnant or other water. The engine drives the vapour (steam) compressor and the pumps of the plant.

In the plant heat from the cooling and exhaust systems of the engine is transferred to the incoming salt water feed. When the water in the evaporator reaches its boiling point the compressor draws off the steam produced and compresses it, returning the compressed steam to the evaporator. The work done by the compressor supplies additional heat to the system, raising the steam temperature by this increase in pressure, which induces further boiling of the salt water. Steam returned by the compressor to the evaporator chest is condensed and withdrawn as distillate (drinking water).

The concentrated salt water is continuously removed through an overflow pipe to prevent the salt water in the evaporator becoming too highly concentrated.

The output of distillate varies with the speed of the engine and the governor is set to maintain a speed that will give the best results for long periods of continuous operation.

Worthington-Simpson, Ltd.

The range of pumping and air compressing equipment shown by Worthington-Simpson, Ltd., of Newark, includes examples of the recently introduced monobloc compressors now made in a number of sizes of from 1 h.p. to 10 h.p. with piston displacements up to 55 cubic feet per minute and delivering air up to 350 lb per square inch according to capacity. In these machines the compressor and motor are combined in a single compact balanced assembly. Either single or two-stage compressors are available in this design, and the firm points out that, in general, two-stage compression gives the more efficient service where operating conditions demand a continuous duty with pressures in excess of 100 lb per square inch. A two-stage compressor, for instance, when working at 150 lb per square inch will deliver 30/40 per cent more air than a single-stage machine of the same displacement, and the power saving per cubic foot of air can be as much as 15 per cent. At the higher range of pressures, two-staging results in lower operating temperatures, which in turn eliminate the formation of carbon on the cylinder heads and valves, ensuring long periods of service between overhauls. Where the duty is intermittent, or below 100 lb per square inch continuous pressure, single-stage compressors with their lower initial cost and fewer parts may be advantageously employed.

An automatic pressure regulator can be supplied, which operates whenever the pressure in the air receiver reaches a predetermined maximum or falls below a required minimum. The mechanism comprises an unloader and relay valve fitted to the cylinder head and piped to the air receiver. When the stored air pressure is sufficient to overcome a spring in the relay valve, a plunger moves down in the unloader to hold open the suction valve, thus preventing compression and allowing the machine to idle on no-load. The cut-out pressure and range are independently adjustable through very wide limits, and when the pressure falls to the lower pre-determined value the compressor cuts in again to take up the full load. Where the air demand is intermittent, however, an electrical pressure switch can be fitted for automatic stop/start operation in accordance with the receiver pressure.

An initial starting unloader, which is entirely automatic, can be fitted to all the air compressors except the two smallest sizes. This unloader allows all air in the compressor to escape when the machine stops, and on re-starting it withholds full-load from the compressor until the motor has attained its rated speed.

In Fig. 7, we illustrate the largest two-stage compressor, which is driven at 1450 r.p.m. by a 10 h.p. motor, has a displacement of 36·7 cubic feet per minute and delivers air at a maximum pressure of 175 lb per square inch. Its construction is typical of that of all except the two smallest sizes of the range of the single and two-stage machines.

The enclosed cast iron crankcase forms a large reservoir for the lubricating oil and carries the vee-set cylinders which have deep radiating fins providing a large cooling surface. These cast iron cylinders have accurately machined and honed bores and are fitted with aluminium heads.

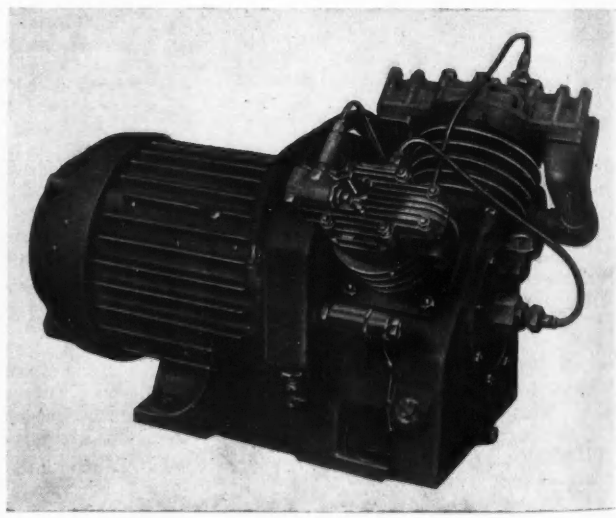

Fig. 7—Two-stage monobloc compressor driven by a 10 h.p. motor —Worthington-Simpson

A forged steel crankshaft is fitted on the coned and keyed end of the motor shaft and

carries the piston rods on roller bearings.

The multiple strip feather valves fitted to the cylinders each consist of only three principal parts—the valve strip, the seat and the guard. The valve strip, which is not rigidly held at any point, is the only moving part, and when closed this thin strip of spring steel covers a slightly smaller slot in the ground face seat. On opening, the valve strip flexes against the curved guard allowing the air to pass on either side. On closing, the strip seats by increasing contact from each end to the centre and destructive impact is eliminated.

An intercooler which is provided only on the two-stage compressors comprises finned tubes fitted between the condensate bottles and

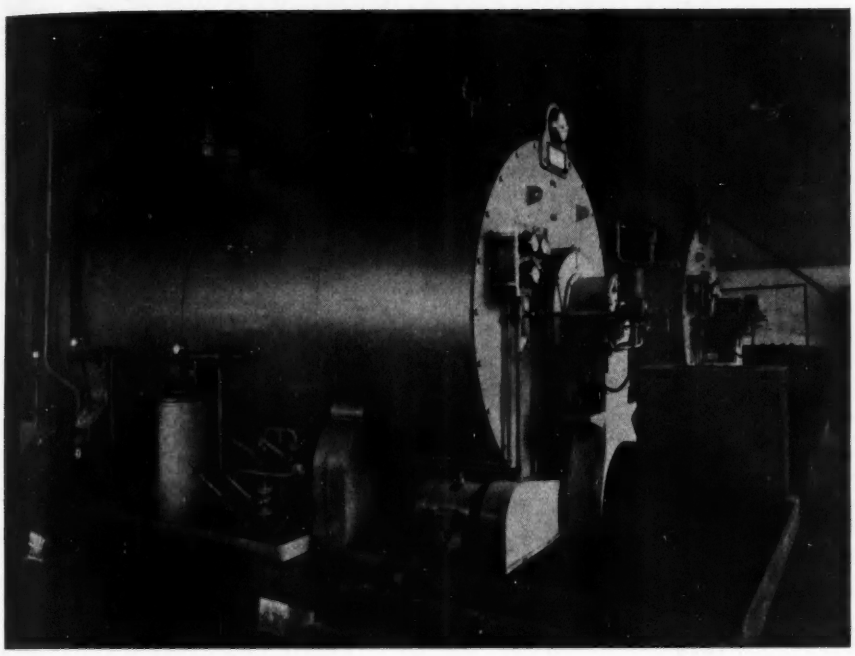

Fig. 8—Installation of " Steambloc " automatic packaged boilers—Babcock and Wilcox

placed in the air stream from the fan, except on the tandem design compressors where the intercooler comprises a continuous coil of finned tube between stages.

Also displayed on this firm's stand are a new line of chemical pumps, made in " Worthite " and stainless steel, for handling acids, alkalis and slurries, and a number of other pumps of different designs and capacities.

Babcock and Wilcox, Ltd.

The equipment being shown for the first time by Babcock and Wilcox, Ltd., includes one of the " Steambloc " automatic oil-fired " packaged " boilers which is handled by the subsidiary company Spencer-Bonecourt-Clarkson, Ltd. These boiler equipments are made in a number of sizes for either steam or hot water and with evaporative capacities ranging from 1500 lb to 18,000 lb per hour. Each equipment incorporates all the necessary auxiliary plant, has automatically controlled oil firing, is fitted with the requisite safety devices, and requires no special house, chimney stack, or foundations.

The boiler exhibited is a comparatively small equipment with an evaporative capacity of about 3000 lb per hour—from and at 212 deg. Fah.—but a typical installation of a larger unit can be seen in Fig. 8.

The equipment is mounted as a complete working assembly on a steel bedplate which facilitates transport and installation. The three-pass boiler of all-welded construction has comparatively small return tubes and its flue is partly corrugated and partly plain. The corrugated flue section is designed to increase flexibility and minimise stresses due to expansion and contraction ; and the plain section at the burner end ensures correct flame development. The boiler shell is lagged and clad with sheet steel to keep heat losses to a minimum, but full access for tube cleaning and inspection is provided by a door at the back end. A feed system at one side of the boiler includes a feed tank, electrically driven feed pumps and a stand-by steam-operated injector. Twin water-level controllers shut the plant down and give the alarm in the event of the level falling too low for safety. Modulating pressure control equipment maintains the operating pressure within close limits and incorporates means of mains high-pressure safety shut down.

The pressure-atomising burner equipment is arranged to deal with the heavy grades of fuel oil up to Bunker " C," both steam and electrical heating equipment being provided. Through the automatic control gear the burner equipment is arranged to give modulated flame control for loads down to one-third of normal rating. Below this load regulation is effected by " on-off " control. Lighting up is by the use of a gas pilot flame ignited by an electric spark which in turn ignites the oil burner. A forced draught fan provides air for pressure combustion and obviates need for the use of an induced draught fan and chimney stack. The automatic control equipment is arranged in a sheet metal cabinet on one side of the boiler and is designed to afford full protection.

The marine exhibits of the firm include a scale model of the " Selectable Superheat " boiler which was described in our issue of September 29th last. This boiler is designed to combine the advantages of the twin furnace controlled-superheat boiler with the simplicity of construction and small floor space of the integral furnace boiler. With this boiler the steam temperature required can be selected and maintained over a wide range of load. In it the gas flow from the furnace is split between two parallel passes, one containing the necessary banks of convection tubes and a superheater, and one containing convection tubes only, the two sections being separated by a stud-tube water wall.

Control of the ratio of gas flow in these two sections is by means of two sets of coupled dampers in the uptakes, one set being open when the other is closed. By simple damper operation the ratio of gases in the " superheater " and " saturated " passes can be varied to give the required final steam temperature. After passing the dampers the gas streams combine, to pass through an economiser and/or an air heater before being discharged through the uptakes to the funnel.

A display of boiler cleaning equipment includes the " Unidirectional " retractable sootblowers, which can be arranged for pneumatic, electrical or hydraulic operation. Other soot blowers exhibited include a small, simple hand-operated unit and a large rack design for high temperature zones where a long travel is required.

A model shows the operation of the Babcock shot-cleaning system for cleaning boiler horizontal tube surfaces where the flue gas temperature does not exceed the ash-fusion temperature. With it metal shot is cascaded evenly from a distributor above the tube banks through which it is dispersed by gravity and the velocity of the furnace gases and serves to dislodge the deposits in the early stage of their formation. The shot and deposit fall towards an inclined-screen separator where a controlled current of air returns the heavy deposit to the gas stream, while allowing the shot to fall into a collector bin, from which it is returned to the distributor either pneumatically or by a mechanical conveyor.

Mono Pumps, Ltd.

A new pump amongst the equipment made by Mono Pumps, Ltd., 1, Sekforde Street, London, E.C.1, is designed for cooling water circulation and has a nominal capacity of 165 gallons an hour. As can be seen in Fig. 9 this pump is of compact design, its dimensions being 11in by 5¾in by 6⅜in ; it is suitable for vee-belt or power take-off drive.

The cast iron body of the pump incorporates a pedestal mounting and the flange-mounted rear half can be easily taken off to expose the stator by the removal of a few socket head screws. The stainless steel rotor runs in a rubber or moulded synthetic stator and is supported in ball bearings at the outboard or driving end and a plain bearing in the end cover. Inlet and outlet connections conveniently arranged at the top of the pump are threaded for ¾in pipe.

Powder handling with Mono pumps will

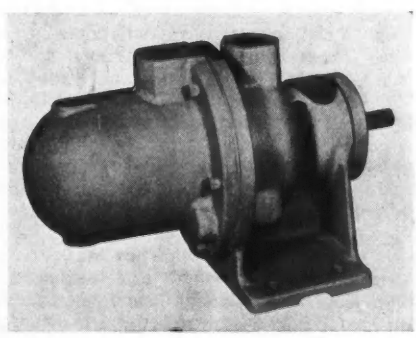

Fig. 9—Cooling water pump of 165 g.p.h. nominal capacity—Mono

be demonstrated on a stand where a pump will vacuum lift powder 5ft and deliver it to the far end of the stand. From this point a second pump will return the powder across the stand.

The makers claim that very little horsepower is required to drive a pump in this application and that air "fluidisation" is unnecessary on some low head installations. Where, due to the nature of a piping system, "fluidisation" is required to reduce friction in the pipeline, the use of air is kept within very low limits. On the demonstration installation, no air is required on the suction side of the pump. On the discharge side free air from 1 to 1·5 cubic feet per minute is used to overcome friction from the piping circuit.

Quasi-Arc Company, Ltd.

Demonstrations are being given by the Quasi-Arc Company, Ltd., Bilston, Staffs, of its portable "Sigma" (shielded inert-gas, metal-arc) welding process, the wire drive and control assembly and welding gun of which are illustrated in Fig. 10. The control assembly incorporates the wire feed drive mechanism, which is electronically controlled, and solenoid-operated water and argon valves. The wire feed gear ratio is 2·14 to 1 and is stated to be suitable for all types of fitted with trigger control for power, argon and water supplies and wire feed, which start automatically when the arc is struck.

A typical example of this firm's range of engine-driven portable welding sets which is shown comprises a 34 b.h.p. Ford diesel engine-driven set with a current range of 60–400A, 55–70V. Other equipment includes single-arc a.c. welding transformers together with a metal rectifier arc welding set used for demonstrations of manual arc welding. New electrodes now available from this company include the mild steel "Zodian" electrodes and the mild steel "Ferron" electrodes for welding heavy sections and restrained joints.

Ruston and Hornsby, Ltd., and Davey, Paxman and Co., Ltd.

What is stated to be the most comprehensive display ever presented by the Ruston-Paxman Group at the Engineering and Marine Exhibition is shown this year on three stands. The exhibits represent the three main ranges of the organisation's oil and gas burning power units—Ruston industrial and marine diesels, gas turbines, horizontal oil engines and diesel locomotives; Ruston-Paxman industrial and marine vee-form diesels; and Paxman light/medium-weight vee-form diesels for traction and oilfield applications.

A separate fuel pump is fitted for each cylinder and is operated by rocking levers from the camshaft. A centrifugal governor is gear driven from the camshaft, and a submerged gear pump for lubrication is driven from the crankshaft. Hand or electric starting is available and a decompressor gear is fitted on all the engines made in this range.

To meet the need for a horizontal diesel engine for installation in railcars, Davey, Paxman and Co., Ltd., Colchester, introduced the "Z.H." engine with four or six cylinders and in powers from 200 to 450 b.h.p. at 1500 r.p.m., either normally aspirated or pressure charged. This engine, the six-cylinder model of which is illustrated in Fig. 11, has a combined crankcase/cylinder block of high strength aluminium alloy with strong cross pieces carrying the seven underslung main bearings. To take side thrust away from the main bearing studs, the deep forged aluminium alloy bearing caps are fitted closely into the frame structure. A large finned sump, cast from aluminium alloy, is bolted on to the bottom of the crankcase and inspection doors are situated in the top of the case. Cast iron replaceable liners are fitted in the cylinder bores and surrounded by water spaces. The pistons are of cast aluminium alloy with a centrally disposed combustion chamber machined in the crown and have three compression rings and two oil control rings. The cylinder heads, which each carry four valves, are cast in sets of three.

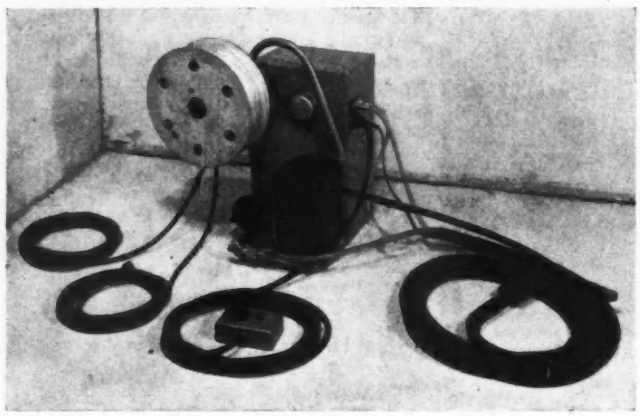

Fig. 10—Portable "Sigma" welding equipment with a wire-drive and control assembly and a welding gun—Quasi-Arc

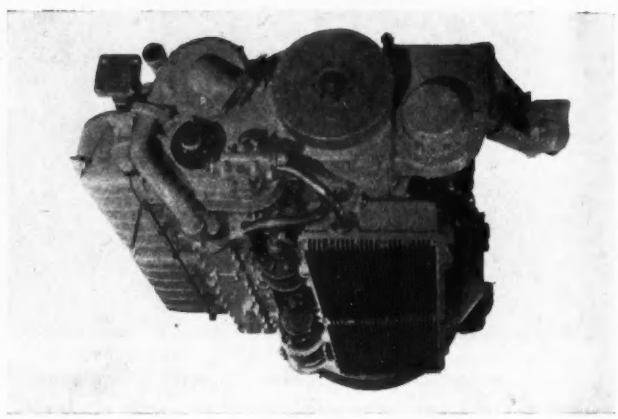

Fig. 11—Horizontal diesel engine for rail traction—Paxman

$\frac{1}{16}$in diameter wire when using positive polarity. It is also satisfactory for many applications, requiring the use of $\frac{3}{32}$in and $\frac{3}{64}$in wire, but if these sizes are used predominantly other feed gear ratios can be supplied.

Power for the set is supplied normally through one of the maker's "MRS425" metal rectifier units, although it is stated that most d.c. generators can be used as a power source. This set comprises a combined transformer, regulator and selenium plate metal rectifier, enclosed in a substantial sheet metal cabinet adequately cooled by a fan. The welding output of the set is 85A to 425A at 55V; the maximum rating is 24kVA, continuous rating 16·5kVA, and the duty cycle is three minutes on, one minute off at 400A. A remote-control box, normally mounted on the set itself, can be placed close to the operator's hand and through it control is provided over the full range of the set by a small rheostat operating at a voltage of 50V. Through this box the operator can adjust the arc length and regulate the wire feed. A convenient inching control can be used to extend the wire to the right distance beyond the argon nozzle before the arc is struck. The water-cooled welding gun is

A recent introduction, the 2, 3, 4 and 6-cylinder Ruston "Y.C." class of heavy-duty, all-purpose diesel engine, is designed for stationary, portable and mobile applications. These four-stroke engines are made in powers from 16 to 72 b.h.p. and with a number of arrangements to suit various duties. They have a crankcase and cylinder of monobloc construction, completely enclosing the main reciprocating and rotating parts, and fitted with renewable wet liners. The crankshaft and connecting rods are steel stampings and all the bearings are of fitted pre-finished, steel-backed, copper-lead lined, construction. Low expansion silicon-aluminium alloy pistons, with three pressure and two scraper rings, which are used in the engines have fully floating gudgeon pins and are completely anodised above the top scraper ring.

The high-tensile cast iron camshaft is driven through gearing by the crankshaft and actuates the valves by push rods and rocking levers fitted with adjusting screws. Water jacketed cast iron cylinder heads carry the overhead inlet and exhaust valves together with the valve gear and injectors.

Fuel injection is by monobloc pump to standard multi-hole injectors. This pump, which is supported on the bottom crankcase cover, is driven by gears from the free end of the crankshaft. The camshaft, located beneath the cylinders, is driven by gears from the crankshaft and the integral cams run in an oil bath and operate roller followers which actuate the push-rods through spherical seatings in the followers.

Either a mechanical or servo-operated governor is provided for engine control, the type depending on the requirements of the engine. An over-speed trip mechanism is fitted to shut down the engine in the event of excessive speed. Pressure lubrication is provided throughout the engine by two gear pumps, a pressure pump supplying oil through a filter element to the main gallery, and the second pump passing low pressure oil through the radiator.

The "R.P.H. Series II" engines made by the company are represented by a four-cylinder engine rated at 167 b.h.p. at 1250

r.p.m. and fitted with a torque converter. This engine, due to its large size and short overall length allied with its high power/weight ratio, is intended to be suitable for use where space and weight are restricting factors. The engine has been designed to allow direct coupling to a single bearing machine, such as a generator, clutch or gearbox.

It operates on the four stroke compression ignition principle and embodies the Ricardo "Comet" Mark III combustion system which, combined with single-hole, pintle fuel injectors, provides flexibility of running over a wide speed range, ability to operate on a variety of fuel oils, and a capacity for efficient running over long periods of service.

The Ruston "T.A." gas turbine, which has a maximum rating of 1410 b.h.p., is displayed with its covers removed to allow internal examination. The machine, which is arranged for burning oil fuel, is representative of those which are now being produced by the firm. Points of special interest on this plant are the air cooling system for the turbines and the kinematic construction employed which facilitates rapid starting and stopping of the machine by ensuring that all hot parts are free to expand and contract as the gas temperature changes.

Marconi Instruments, Ltd.

It is frequently required to undertake the radiographic examination of work or components not readily accessible to stationary sets and for this class of work a low-powered portable equipment with a demountable tube head has been developed by Marconi Instruments, Ltd., St. Albans, Herts. This equipment, illustrated in Fig. 12, is primarily suitable for the examination of plastics, fibrous materials, aluminium and magnesium and their alloys. It has a maximum rating of 85kV peak, which is sufficient for radiography of small ferrous sections.

The complete apparatus is readily dismantled into its essential parts, each having a handle and being easily carried by one man. The tube head contains the X-ray tube, together with its high-tension and filament transformers, all oil-immersed in one compact assembly. The tube head is flexibly mounted on a tube arm with swivelling fork. The arm is supported on a self-locking, crank-operated carriage, which is vertically adjustable on a tubular steel column. The compact control unit is contained in a steel case with controls and meters mounted on a sloping panel and having a hand timer connected by a 6ft lead. The control unit and column are mounted on an aluminium frame base with rubber-tyred castors.

For many applications only the tube head and control unit are required and these can be either mounted permanently in some position convenient for the particular job or carried by hand to the site.

The company is also exhibiting its industrial "TF1555A" X-ray apparatus, which has a range from 30kV to 250kV in 2kV steps and is designed to permit the examination of components varying from plastic and aluminium items to ferrous sections up to at least 3in thick.

The high tension generator for this equipment is oil-immersed in a welded steel tank and is connected to the X-ray tube by flexible high tension cables. The twin Greinacher circuit employed provides a smoothed, electrically stabilised output of 250,000V at up to 15mA. A point of considerable importance is that this constant potential generator enables the whole of the high voltage energy to contribute to X-ray generation, ensuring maximum X-ray output and hence exposure times shortened by half.

The screened tube head carries an optional filter/shutter assembly with motor-driven, remotely controlled lead shutters and an interchangeable filter. The tube, which is contained in a shockproof, ray-proof shield, is cooled by oil which is pumped into the hollow copper anode, whence it flows between the glass envelope and tube-shield to the return pipe. The oil circulator/cooler comprises an oil reservoir with immersed cooling water pipes and an electrically-driven pump which forces the oil to the X-ray tube. This unit, which has temperature, pressure and level gauges mounted on its front panel, incorporates an automatic water valve and temperature and pressure safety switches.

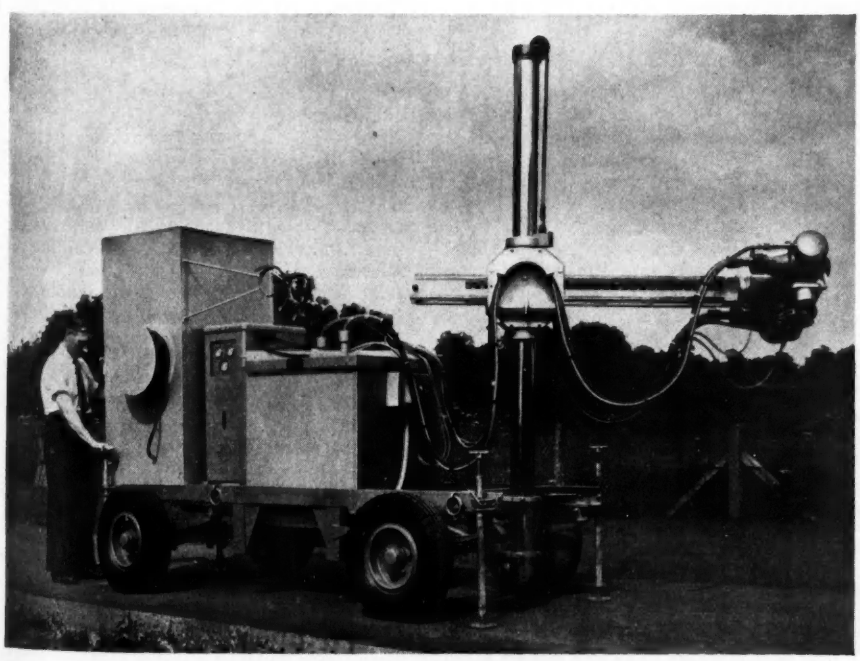

Fig. 12—Trailer-mounted 250kV industrial X-ray apparatus—Marconi

Alternative forms of tube mounting available with this equipment include gantry, single-column or overhead rail suspension means, while in a trailer version the entire equipment is mounted on a wheeled trolley, permitting the easy radiographic inspection of welds and castings, irrespective of size.

The control unit bears on its front panel all the meters and controls necessary for remote regulation of the exposure. The timer may be set from a fraction of a minute up to sixty minutes, while the tube current is continuously variable from 5mA up to the maximum rating of the tube.

Dowty Hydraulic Units, Ltd.

Four sizes of a new gear pump for pressure deliveries up to 2500 lb per square inch and with a wide range of output flows from 1 to 50 gallons a minute, are shown with the hydraulic rams, valves, &c., made by Dowty

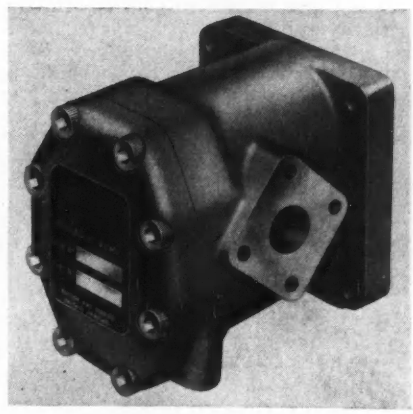

Fig. 13—Hydraulic pump made in four sizes for capacities from 1 to 50 gallons per minute at 1500 r.p.m. and suitable for working pressures up to 2500 lb per square inch—Dowty

Hydraulic Units, Ltd., Ashchurch, Glos. These pumps were designed to incorporate the minimum number of component parts and have a pressure balancing system which, combined with close radial tolerances between the gear teeth and bores, gives a high volumetric efficiency.

The general construction of one of the new pumps can be seen in the photograph we reproduce in Fig. 13. The gears are mounted on plain bearings and internal

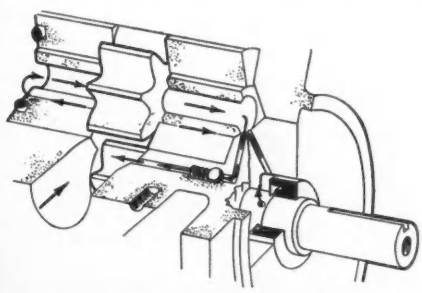

Fig. 14—Pressure fluid balancing system of gear pump—Dowty

leakage between the gears and side plates, owing to the need for operating clearance, is virtually eliminated by feeding the output pressure to the outer ends of one pair of bearing bushes in the pump assembly, as shown in the diagram, Fig. 14. The annular areas upon which this pressure acts are suitably proportioned by the use of "O" rings, and a controlled force is provided to hold the bearing bushes in contact with the gear faces. This force slightly exceeds

the load tending to "open" the bushes during pumping.

In the system, each of the bearings is supplied with a metered quantity of lubricant from the gear meshing point. This lubricating fluid is returned from one end of the pump, as shown, through a low-pressure valve in the body. A positive pressure is thus maintained inside the pump at all times, a single shaft seal being used to retain the oil.

The pump is built on the cartridge principle and alignment troubles are eliminated, as the bushes which function as bearings and side plates and also position the gears, are all located in one assembly and are affected by one centre distance only. Using four basic sizes, fourteen different capacity pumps are available in this new range, and with them twenty-four different forms of pipe connections can be used.

Laurence, Scott and Electromotors, Ltd.

Demonstrations of specialised electrical machines for frequency conversion and speed control are being given by Laurence, Scott and Electromotors, Ltd., Norwich. They include a working exhibit showing the characteristics of the "N-S" motor with "Asrec" speed control. The "N-S" motor, to which the "N-S" motor is coupled.

Another exhibit consists of an alternator with "Altoreg" control: a 7½kVA self-excited alternator with "Altoreg" control is driven from the "N-S" motor of the exhibit described above and can be loaded by a 5 h.p. induction motor fitted with a mechanical brake. The "Altoreg" system employs two separate excitation windings, the main winding being excited by the load current through a current transformer/rectifier system. In its simplest form the alternator is made self-excited by supplying the second or auxiliary winding from a rectifier connected across the output terminals. For self-excited machines a regulation of approximately ±5 per cent throughout the rated load range can be achieved, with a very high speed of response. The former characteristic is demonstrated by varying the load on the motor supplied from the alternator (by the use of the mechanical brake) and the latter by switching the motor direct on to the alternator, as shown by oscillograms. The motor is a 5 h.p., 1000 r.p.m. "Trislot" motor, designed to take a starting current of about three and a half times full-load current and to develop one and a half times full-load torque.

on the motor and a stroboscope to indicate rapid and accurate response. The potentiometer of the demonstration machine is hand-set, but may be actuated from mechanism responding to changes such as changes in tension, gas pressure or rate of flow of liquids, &c. The speed may also be controlled relatively to the speed of another machine—in a sectionalised drive, for example.

To overcome the difficulties of demonstrating full-size winches under working conditions the company is showing a number of models, one of which is a miniature working model (Fig. 15) of the Pitt-Scott-Johnson mooring winch, arranged to show its constant tension characteristics. This kind of winch is designed for use on Canadian ore carriers which must negotiate a number of locks and for similar duties. It is used to check the way on a vessel and to maintain constant selected tension in a mooring line. The winch is operated by direct current and has a 50 h.p. motor driving through an epicyclic system of gearing with an additional oscillating member which is used to operate the automatic control switch. A manual control lever on the winch is used to select the tension setting, which gives a range

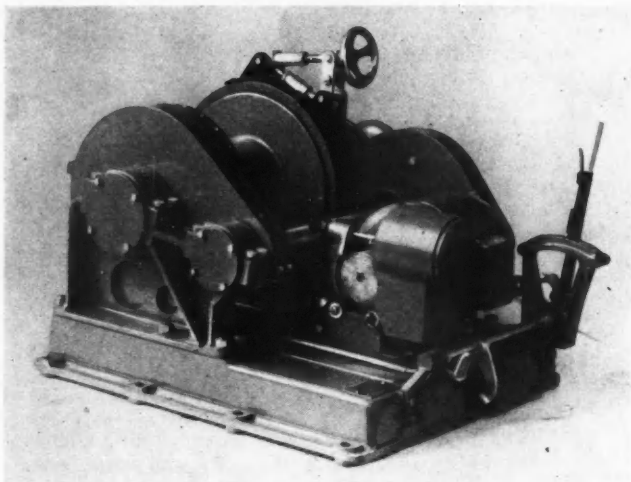

Fig. 15—Pitt-Scott-Johnson mooring winch designed to maintain constant tension in a mooring line—Laurence, Scott

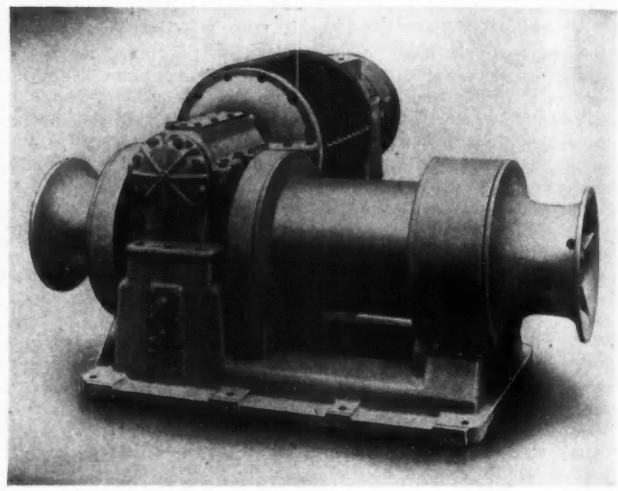

Fig. 16—"Revcon" cargo winch for direct connection to a.c. supply—Laurence, Scott

it will be recalled, is a stator-fed, variable-speed a.c. current motor which can be adjusted in speed over a wide range under all loading conditions, without brush movement. Its induction regulator (which regulates the speed) may be operated by hand, by remote push button, or from automatic devices of almost any required type.

In the demonstration at this exhibition the automatic speed control device takes the form of an "Asrec" control equipment, which is a simple standardised system employing a sensitive polarised relay and stabilising circuits with a d.c. tacho-generator and potentiometer for the signal and reference voltages respectively. The "Asrec" equipment is designed to cover as far as possible the very wide range of automatic control requirements in connection with "N-S" motors from simple speed controls, such as that exhibited, to complex multi-motor process controls. The system is designed to maintain the speed at the required value under varying load conditions to within ±1 per cent of the maximum value. This performance is demonstrated by varying the load by means of a mechanical brake, or by loading the alternator

The company is also showing a system of electronic speed control which has been developed for use in conjunction with the "N-S" variable-speed motor for applications requiring very precise speed control. The system is known as "Velonic" speed control; it comprises a potentiometer, fed from a stabilised d.c. supply, which is hand-set in accordance with the desired speed. The difference between the resulting potentiometer voltage and the voltage generated by a tacho-generator coupled to the "N-S" motor (which is a measure of the difference between the desired and the actual speeds) is fed to a suitable amplifying circuit and thence to the two opposed field windings of a d.c. servo-motor. The latter drives the induction regulator of the "N-S" motor until the speed of the latter equals the desired value, when the field of the servo-motor becomes zero and it stops. Adequate provision is made to eliminate any tendency to hunting. The device is designed to control speed to within ±2 r.p.m. with supply voltage and/or frequency variations of ±10 per cent and load variations from zero to full load. The demonstration enables these characteristics to be shown by means of frictional loading

up to 15,000 lb in steps of 2500 lb (under automatic control the maximum pull is 20,000 lb). The remote controller has five positions: "Off," "Auto," "Fast Heave," "Slow Veer," and "Fast Veer." When it is on the "Auto" step the winch will pay out or heave in cable automatically as the water level in a lock falls or rises, maintaining the selected tension; the "Heave" and "Veer" steps are used for paying out cable and checking way on a ship under hand control.

Among the "static" exhibits is a new kind of winch for operating from an a.c. supply, without conversion. It is known as the "Revcon" winch; the specimen exhibited is rated at 3 tons and is remote controlled, with contactor gear arranged for mounting in a deck house.

The "Revcon" winch (Fig. 16) is driven by a pole-change slipring induction motor, controlled to give a range of stable speeds without requiring friction brakes or other devices to control the load. Pole changing gives four steps in each direction, the top speed coming into operation only if selected by the operator and if the load is suitable. The load/speed curves are stated to be flat on each step, with smooth speed changing.

Teleflex Products, Ltd.

A working demonstration of the 0·705 overhead cable conveyor and "Tele-line" reciprocating cable conveyor is to be seen on the stand of Teleflex Products, Ltd., Chadwell Heath, Essex. Static sections of the firm's dual directional chain conveyor are also shown. This "Tele-line" unit is a recent development in the company's range of mechanical handling equipment and uses similar cable to that incorporated in the overhead cable conveyors, although the movement principle is different.

Mechanical remote control equipment on display covers marine, industrial and window gear installations, and the marine controls shown include throttle, reverse, choke and stop/start controls.

On show for the first time will be a "Teleflex-Pantatron" gamma radiography equipment for industrial, non-destructive testing, utilising radioactive isotopes in place of the conventional X-rays.

Spencer and Halstead, Ltd.

The blast cleaning equipment made by Spencer and Halstead, Ltd., Ossett, Yorks, includes a newly-developed continuous barrel machine called the "Automat" which is illustrated in Fig. 17. This machine is suitable for continuous line production and either accepts components for cleaning as a batch, or it accepts individual parts and stores them until a suitable batch has been collected. The batch of parts is automatically admitted through the front of the machine and into a blasting chamber where they are blasted for a predetermined time. At the end of this operation the cleaned batch is automatically ejected and the next load accepted. It will be seen that the "Centriblast" impeller assembly is mounted on the machine cabinet and a shot recovery and elevator unit is mounted on one side.

A "Centriblast" airless shot blasting cabinet machine is now made with two rotary tables arranged on a bogie so that whilst the work is being blasted in the cabinet on one table the other can be unloaded and reloaded. At the end of the blasting period the bogie is simply traversed through the cabinet for the load to be cleaned on the one table whilst that on the other is removed from the machine. During the whole of the period that the machine is operating it is not necessary to stop the rotation of the abrasive impeller wheel, and thus maximum blasting capacity from one wheel is utilised. The turntables provided are each 3ft 3in diameter and can be loaded to a height of 12in above turntable surface with a maximum load of some 5 cwt. This machine can also be fitted with two trunnion supports in place of the turntable units to facilitate the cleaning of cylindrical objects which are rotatable.

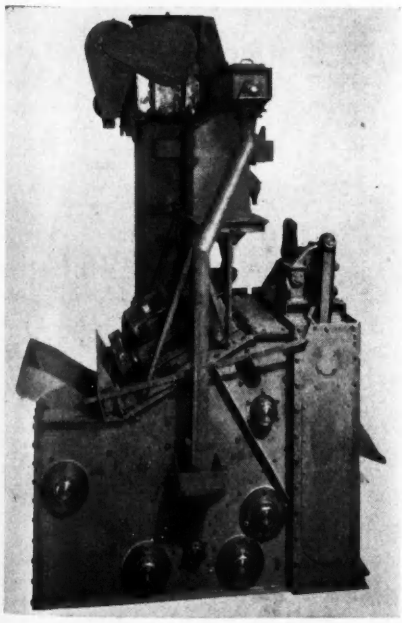

Fig. 17—"Automat" continuous barrel cleaning machine for castings and components—Spencer and Halstead

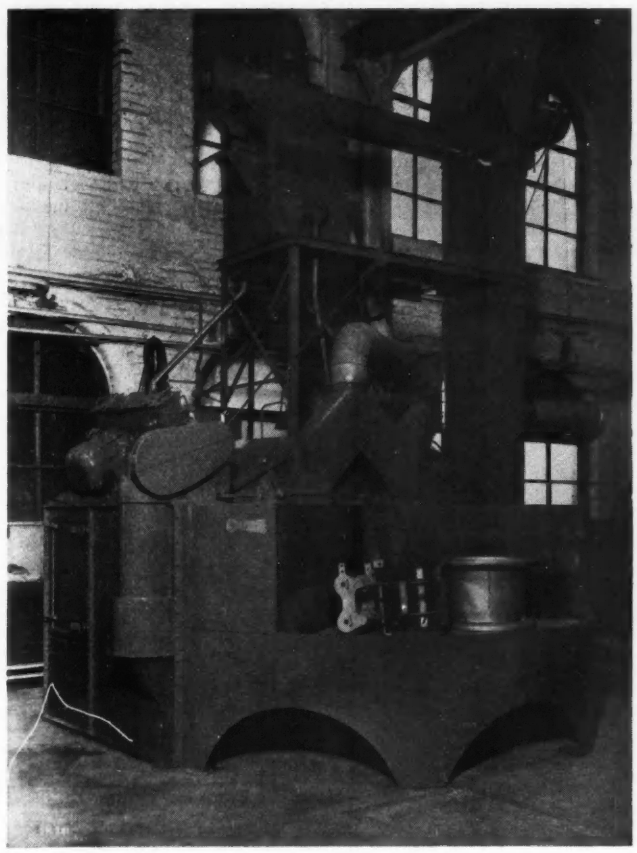

Fig. 18—11ft rotary table blast cleaning machine installation—Spencer and Halstead

The 11ft diameter rotary table machine, illustrated in Fig. 18, has a 4ft wide loading track and takes work up to 18in high. Individual pieces weighing up to 700 lb can be loaded on the table which will carry a total load of some 4 tons. The plain turntable comprises a substantial centre post, mounted in heavy duty ball thrust and journal bearings, and provided with a series of fabricated arms which are connected to a heavy peripheral rim. The upper surface is covered with renewable plate segments which are perforated to allow abrasive to pass through into the return system. The table is driven at its periphery through a rubber bonded friction pulley by a gear reduction unit and 2 h.p. totally enclosed squirrel cage motor. Between the motor and the gear reducer a step cone vee-rope drive provides three alternative table speeds. The blast chamber is of rectangular form round the rear half of the table, whilst a semi-circular front section guards the table edge and supports the spent abrasive collecting pan. The roof of the chamber is equipped with supports for two impeller units and the upper bearings for the turntable centre post, whilst from the front edge of the chamber extended canopies and multiple rubber curtains are suspended to shield the entry and exit ports.

Two "Centriblast" centrifugal impeller units are positioned so that the abrasive, in addition to approaching the table surface at an angle of 60 deg. is thrown towards the table centre by one impeller and away from the centre by the other. This arrangement enables all exposed surfaces and edges of the work to be cleaned.

Each impeller is of the firm's improved 16in diameter, multi-bladed design driven by a 14 h.p. 3000 r.p.m. motor and enclosed within a heavy mild steel fabricated guard, lined and protected with replaceable wearing plates.

After impinging upon the work, the abrasive, together with sand, cinders, flashings and other foreign matter falls into a receiving hopper below the blast chamber and is passed by a spiral conveyor directly into the boot of a bucket elevator. The mixture of reusable abrasive and foreign matter is delivered by the elevator into a short spiral conveyor feeding into a rotary screen where all oversize materials are rejected and delivered via a gravity chute into a collecting box. Re-usable abrasive and undersize foreign matter then enter a desilter, passing over a stratification plate from which the material falls in a thin curtain. Sand and silt are drawn out by air suction whilst the relatively dense abrasive gravitates into the storage hopper below for re-use.

A primary fines settling chamber is provided in the desilter to allow rejected sand to pass via a chute to ground level, whilst the fine dust from the abrasive, together with dust exhausted from the blast chamber, is drawn through ductwork to a dust arrester.

To provide air for ventilation and dust control, a rigid screen filter having a capacity of 4000 c.f.m. is supplied. The dust storage hopper has directly above it an aspirator chamber, containing timber-framed, cloth covered air filtration screens, together with the necessary tensioning sealing, and hand operated rapping devices. Above this chamber is mounted a centrifugal fan driven through vee-ropes by a totally enclosed motor.

Consolidated Pneumatic Tool Company, Ltd.

The 120 cubic foot compressor shown by Consolidated Pneumatic Tool Company, Ltd., and illustrated in Fig. 19, incorporates a sliding vane rotary compressor, including two stages coaxial in one assembly, driven by a Perkins four-cylinder diesel engine through a friction drive. This compressor operates flooded in oil, which not only serves to lubricate the machine and seal the valves, but also effectively cools the air charge. The oil being in intimate contact with the air and the compressor interior, heat transfer conditions are favourable, and the makers claim that with perhaps 2 per cent by volume of oil

the temperature rise through the compressor is of the order of 100 deg. Fah. when delivering at 100 lb per square inch. A separator is provided to recover the oil from the delivery air, and the carry over of oil is found to be less than with a piston compressor. Regulation between 100 and 60 per cent full load is by varying engine speed, and at lower loads by varying speed combined with progressive throttling of the compressor intake. The servo motors for these functions work on air pressure supplied by the main compressor. Air pressure also serves to pass the oil from the separator, through the cooler, to the gear pump metering it into the compressor. The maximum working pressure is 125 lb per square inch, and the set, on a two-wheeled chassis as illustrated, weighs 3200 lb.

Fig. 19—120 cubic foot "Power Vane" compressor—Consolidated Pneumatic

Fuel Firing, Ltd.

A prominent exhibit of Fuel Firing, Ltd., Woodley, Reading, Bucks, is one of the firm's initiators—an auxiliary oil firing unit for use with pulverised fuel fired boilers. One of these installations was illustrated and described in detail in our issue of July 29th last. The initiator shown on the stand operates through its full cycle on an automatic timing circuit with a white electric light bulb in place of the atomiser, to simulate the establishment of flame, and a red bulb on the ignitor showing when current is applied to ignite the flame.

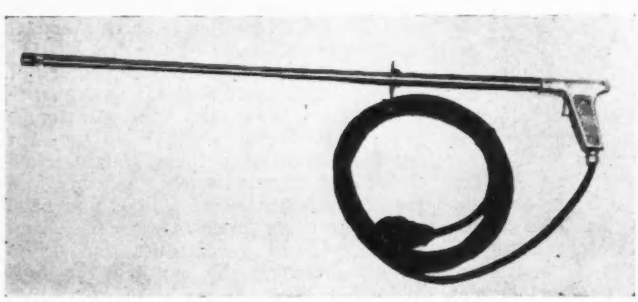

Fig. 20—Portable electric igniter for burners handling heavy fuel oil or gas —Fuel Firing

A portable electric igniter, shown operating on an automatic timing circuit, was developed by the firm for the purpose of lighting-up burners handling heavy fuel oil or gas.

This igniter (Fig. 20) comprises a light stainless steel tubular casing carrying at one end a carbon block against which a carbon rod electrode is pressed lightly. The contact point between the two carbon elements glows immediately at white heat when a supply of electricity is passed between them at a potential of approximately 20V a.c. The head of the igniter which contains the carbon elements is slotted to permit the combustible fluid to reach the hot spot, and is also removable to facilitate renewal of the carbon elements. The tubular casing has at the outer end a light alloy pistol grip handle containing a trigger operated switch.

Electrical connections are made to the igniter by means of a five-core, tough rubber sheathed flexible cable entering the bottom of the handle, and terminating at the opposite end with a plug arranged for insertion into a suitable socket in the side of a portable transformer supplied with the igniter. The unit is stated to be unaffected by cold oil or high gas pressures, and for this reason it is not only suitable for igniting burners in furnaces at virtually atmospheric pressure, but also for lighting burners inside furnaces under pressure, as, for example, gas turbine combustion chambers. It has been found that an ordinary marine type of oil burner can be lit under full forced draught pressure.

The "F.F.M." modulating wide range burner developed by the firm has a patent air swirler just behind the position of the oil sprayer, and which admits combustion air around the oil spray with a swirling motion at high air velocity, thereby creating violent turbulence in the combustion zone which is essential for complete combustion to take place. In this modulating swirler, the quantity of air is controlled over a wide range, but it leaves the swirler at a sensibly constant velocity regardless of quantity, so that violent turbulence is produced at all burner rates.

The fully modulating swirler embodied in the type "F.F.M." burner comprises a number of thin polished stainless steel blades, secured at their outer periphery to pegs inside the air director tube, the back edge of the blades being attached to radial channel ribs forming a spider which is free to slide inside the burner tube, co-axial with the oil sprayer. Movement of this spider backwards and forwards, coaxially with the sprayer tube, changes the curvature of the blades which are sprung in such a manner as to change the area of air discharge, and, hence, the quantity of air admitted to the combustion zone. In this manner the rate of air flow varies, but the velocity of discharge from the swirler remains sensibly unchanged.

Control of the curvature of the blades is achieved by moving a tube arranged coaxially with the sprayer tube, the movement of this tube being effected from the back plate of the burner by means of hand-operating gear or remote control.

The sprayer employed in the burner is of the return flow or "spill" type, in which the quantity of fuel actually discharged from the sprayer into the combustion zone can be governed over a wide range by changing the pressure in the central return flow pipe from the atomiser. By providing suitable means for varying the pressure in the return line from the atomiser, the quantity of fuel discharged from the atomiser can be varied over a wide range without the quality of atomisation deteriorating.

The control of the blades of the swirler can be readily coupled to the control of oil flow in the return line from the sprayer, so that the control of air and oil flow takes place simultaneously and sensibly constant fuel/air ratio can be obtained at all rates of burning within the range of the burner. The firm states that the burner can be made to burn satisfactorily over a turn-down range of 5 : 1 and under certain conditions this range can be widened.

Teddington Industrial Equipment, Ltd.

The electric control device called the "Spediflam," made by Teddington Industrial Equipment, Ltd., Windmill Road, Sunbury-on-Thames, Middlesex, is claimed to be capable of operating all types of oil-fired burners. It acts by controlling the pump supplying oil to the burner and the ignition system; the principal detector is the stack switch seen behind the unit in our illustration, Fig. 21.

Immediately on demand a circuit is provided to the ignition transformer and the

Fig. 21—"Spediflam" electric control instrument for oil burners—Teddington

burner pump. Assuming a normal start-up, the stack switch contacts change over and the plant continues to run normally until no longer required. In the event of flame failure, the stack switch safety contacts break and isolate the burner watcher, stopping the pump within thirty seconds. When the flue is cooled sufficiently, the restart thermostat contacts close. This provides the purging period and normal restart then occurs. On mains supply failure, the pump stops immediately and the operating sequence is then identical to the flame failure sequence. If the flame is not established during the normal start up, after a time lag normally factory-set to twenty-five to thirty seconds (but adjustable from fifteen to fifty-five seconds), the lock-out relay operates, isolating the burner watcher, and the warning lamp glows. At this stage it is necessary to

depress the reset button to obtain further operation of the unit. All components are arranged so that in the event of failure the burner watcher fails when safe. The burner watcher will fail safe in the same way in the event of accidental damage to the external wiring.

In addition, there is a wide range of ancillaries to adapt the burner watcher to particular processes, such as space heating in a building. The electric supply can be 200/250V or 400/440V, and three-phase motors can be controlled : the external control and alarm circuits are 24V only.

A variety of other control equipment for processes and engines, both mechanical and electrical, is on show.

James Howden and Co., Ltd.

Practically all the space on the stand of James Howden and Co., Ltd., 133, Barfillan Drive, Glasgow, is devoted to displaying the design, operation, driving, &c., of the Howden compressor, which is a development of the Lysholm compressor.

The Howden compressor is a lobe design positive displacement, high-speed rotary machine having no reciprocating parts. Its inherent advantages are stable pressure-volume characteristics, freedom from vibration, small size and low weight, and its robust design is stated to ensure a high degree of reliability and a minimum of maintenance. In Fig. 22 we illustrate a compressor which is exhibited with a cut-away casing showing the rotors and shafts slowly rotating. The working parts of the compressor—that is, the parts which come into contact with the gas and compress it—comprise two helically lobed intermeshing rotors which rotate within a closely fitting main casing bored out in the form of two intersecting parallel cylinders. The main casing is closed at one end by a cover containing the inlet port and at the other end by a cover containing the discharge port. As the rotors revolve and the lobes unmesh, air or gas is drawn in, filling the spaces between the lobes and the main casing and it is carried round the casing until remeshing of the lobes compresses the air or gas and finally discharges it through the outlet port.

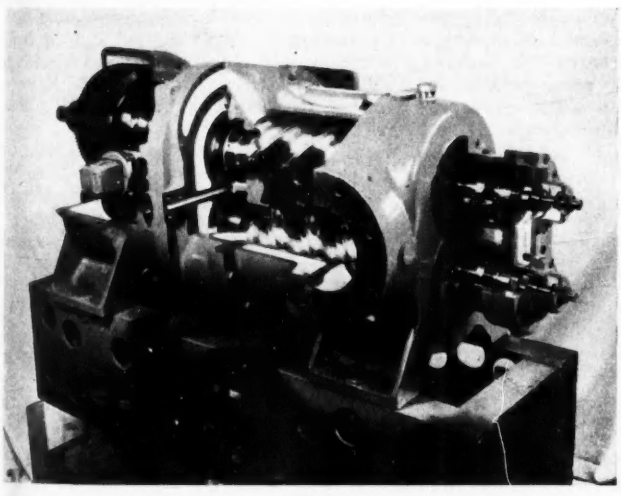

Fig. 22—20mm rotor compressor with casing cut away to show operation of the rotors and shafts—Howden

The rotor form is so arranged that gas, during the compression period, is sealed in the interlobe space and is not in communication with any other lobe space or with the inlet or outlet. By rotation and intermeshing of the rotors the sealed gas is compressed to give the required delivery pressure so that under design conditions, on release to the outlet, there is no back flow of gas into the lobe space. Thus, whilst in the Roots type of blower the volume of trapped gas is constant and the pressure is raised at the moment of delivery, in the Howden compressor the compression approaches an adiabatic process. The adiabatic compression before release effects a large saving of power at high-pressure ratios and this, point out the makers, gives the Howden compressor a higher efficiency than the Roots blower.

The rotors and casings are accurately machined to provide fine running clearances between the meshing lobes, between the tips of the lobes and the main casing and between the end faces of the rotors and the end covers. No lubrication is necessary in the working space, and the delivery from the compressor is uncontaminated. The rotors are maintained in their correct angular relationship by synchronising gears which are set during assembly. Only about 5 per cent of the total input power is transmitted through the synchronising gears to the mating rotor, nearly all the power being transmitted by the air or gas being compressed.

In the smaller machines of the standard range the rotors are integral with their shafts, which run in plain journal bearings in the end covers of the compression chamber. In the larger machines, stub shafts are fitted to the rotors and the bearings are outboard of the end covers. The journal bearings for the rotor shafts are of shell, steel-backed design, with white-metal linings. The axial thrust due to compression is absorbed by tilting pad thrust bearings. Oil throwers prevent lubricating oil travelling along the shaft to the specially developed compression space seals in the inlet end cover of the compressor, which prevent ingress of atmospheric air to the working space. In the discharge end cover similar seals prevent leakage of compressor working substance to atmosphere.

The firm is now manufacturing four standard sizes of these compressors, having rotor diameters of 125mm, 200mm, 10·5in and 16·5in. This range covers capacities from 400 c.f.m. to 8500 c.f.m. with discharge pressures up to 60 lb per square inch gauge in one stage, higher pressures being obtained by using two or more compressors in series. As a vacuum pump with atmospheric discharge a single machine is suitable for inlet pressures down to 4 lb per square inch. The standard compressors are suitable for handling air and other non-corrosive gases or vapours, while for corrosive gases or vapours, special materials can be employed. As they have no internal lubrication and running clearances exist in the compression space, the compressors are stated to be particularly suitable for duty in dust-laden atmospheres.

Fig. 23—Heat treatment furnace rated at 50kW and having a charge space 4ft by 2ft 6in by 1ft 6in—Birlec

The sectionalised 200mm compressor on view has a capacity of from 800 c.f.m. to 2000 c.f.m., F.A.D. corresponding to rotor speeds of approximately 5000 and 11,000 r.p.m. respectively. This compressor is normally fitted with a speed-increasing gearbox so that it can be driven by an electric motor or by a high-speed diesel engine. For a steam or gas turbine drive the compressor can be directly coupled without the use of a gearbox.

Birlec, Ltd.

A particularly good example of the way in which modern furnace equipment can be built to combine clean lines with ease of operation is the recently introduced "H.R.P." heat-treatment electric furnace on the stand of Birlec, Ltd., Tyburn Road, Erdington, Birmingham, 24. This furnace is made in two sizes, one rated at 50kW with a charge space 4ft long, 2ft 6in minimum width and 1ft 6in minimum height ; and the other rated at 70kW with a charge space 5ft by 3ft by 1ft 6in. The smaller of these two furnaces is exhibited and is illustrated in Fig. 23.

The furnace is designed to give a temperature uniformity of ±10 deg. Cent. over a temperature range of 700 deg. to 1050 deg. Cent. It has a hard wearing hearth of high-grade alumina firebrick which is particularly resistant to abrasion and spalling.

To assist the handling of heavy charges the charge space has been left clear, the elements being entirely removed from the side walls and secured by hook-pins on the underside of the arched heating chamber roof. Further elements are located in slots

beneath the hearth slabs, to assist temperature uniformity, and they are easily removable for inspection or replacement. With this arrangement the standard nickel chromium ribbon elements are protected from the possibility of mechanical damage when castings or similar pieces are being pushed into or dragged out of the furnace. An additional heating element is inserted in the door brickwork to counteract inevitable heat losses at this point. This element is separately zoned and switches off and on as the door opens and closes.

The door gear is completely enclosed within the furnace casing, the counterweighted mechanism extending over the top of the furnace, with the weights themselves located in a compartment at the rear. This compartment is also used to accommodate the two transformers—one for the main elements and the other for the door element—access also being available to the element connections.

The firm is also showing an example of one of its "Lectro Dryer" installations, which are used in the humidity control of compressed air, process gases and other applications. This equipment is non-chemical in action, drying being effected by the absorption of moisture on activated alumina from air, gas or other media passed through it. It is designed to maintain dewpoints down to minus 60 deg. Cent. and control relative humidities at 5 per cent.

C. A. Parsons and Co., Ltd.

The main exhibit on the stand of C. A. Parsons and Co., Ltd., Newcastle upon Tyne, is the completely bladed high pressure cylinder (bottom half) for a 60MW, 3000 r.p.m., three cylinder turbo-generator, illustrated in Fig. 24. This machine is designed for a steam pressure of 900 lb per square inch pressure and 900 deg. Fah. temperature. The blading is arranged on a constant mean diameter which enables the cylinder to be constructed with a perfectly straight and parallel flange. An interesting point in design is the elimination of vertical bolts on the horizontal joint and the fundamental change in the design of the flange. The two halves of the cylinder are held together by clamps that are applied or taken off by movement in the horizontal direction. The flanges are very narrow and deep, the upper face of the top flange and the lower face of the bottom flange being machined at a slope of 1 in 8 to the horizontal. The jaws of the clamps are machined to correspond, and the clamps are slipped on over the flanges and the horizontal studs in the two halves of the cylinder.

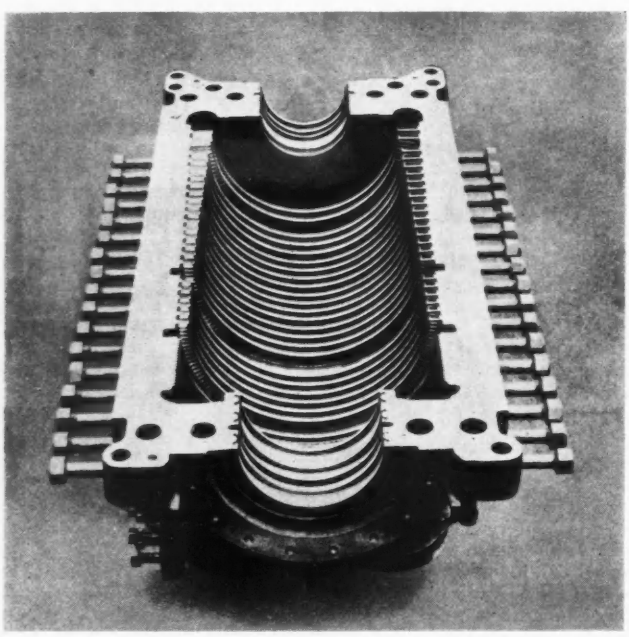

Fig. 24—Bottom half of h.p. turbine cylinder showing arrangement of clamp bolts—Parsons

Also shown is the auxiliary shaft for a 60MW steam turbine, which is driven from the high pressure shaft by a worm and worm-wheel. The main oil pump wheels, one for the power oil and the other for the lubricating system, are mounted on one end of the shaft, while on the other end is coupled the speed control governor. Connected to the governor is the plunger which controls the pilot oil pressure to the governor valves by uncovering ports in the regulating bush depending on the speed of the turbine, and thus adjusting the opening of the governor valves.

A speed reduction gear exhibited is used for the exciter drive on a 60MW turbo-generator and gives a speed reduction from 3000 r.p.m. to 1000 r.p.m. In it the pinion is coupled to the generator rotor through a splined torsion shaft forming a flexible quill drive. A fan is mounted on the outboard end of the pinion shaft for dealing with the ventilating air for the exciter. Oil from the turbine lubricating oil system is supplied under pressure to the gear bearings and through oil sprayers to the gear teeth. Lubricating oil is also fed into the hollow pinion for lubricating the splines of the torsion shaft.

C.A.V. Ltd.

Amongst the representative examples of the fuel injection equipment and electrical equipment made by C.A.V., Ltd., of Acton, London, W.3, there is shown the recently introduced paper element fuel oil filter with single, twin and triple bowl arrangements. This filter is smaller and more compact than previous filter models made by the firm and is designed to remove the smallest abrasive particles of dust carried in suspension in fuel oil.

The general arrangement of the new filter can be seen in the illustration Fig. 25 and a triple bowl unit is shown in Fig. 26. It is mounted in the usual way in the fuel line with the inlet on one side of the bowl head and the outlet on the opposite side. The paper element is contained in a thin metal canister and the paper strips from which it is formed are wound round a cylindrical core in the form of a spiral. These strips are cemented together at the top and bottom to form continuous vee-shaped coils and provide a very large filter area of some 560 square inches. With this design it is stated that the filter area provided is six times that of the firm's normal cloth filter and within a bowl about two thirds the size. It will be appreciated from the "cut-away" photograph reproduced in Fig. 25 that when the filter is in use the dirty oil is confined to the undersides of the paper coils and the filtered oil to the upper sides.

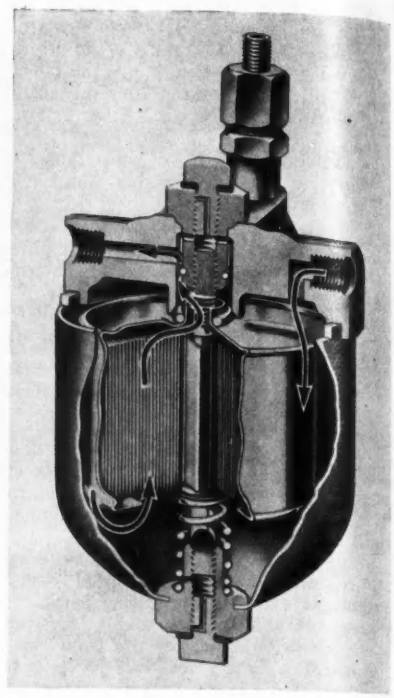

Fig. 25—Arrangement of paper element fuel oil filter—C.A.V.

The paper used for the filters is specially impregnated and has a high strength when wet and the elements have been successfully subjected to tests at high and low temperatures, severe vibration and at different pressures. The elements are designed for easy replacement in the units and they are discarded when choked after service. The makers state that the paper element has proved so successful in service that sets of parts for converting many C.A.V. felt or cloth element filters have been made available. Conversion is simply carried out, it being necessary only to discard the existing element and seating washer and to assemble the paper element and fittings on the centre bolt according to the instructions provided.

A duplex filter with paper elements made, is a twin-bowl unit incorporating a two-way valve which enables one filter to be serviced while an engine is running on the other.

Amongst the starters shown in the electrical section are the firm's "axial" and "non-axial" types, and they include a 7in diameter heavy-duty model with two-

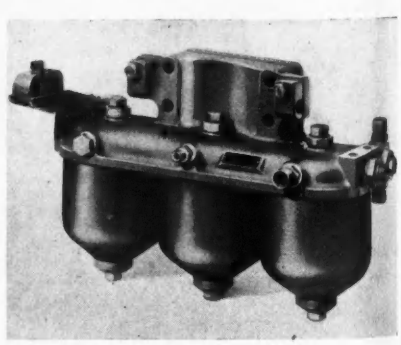

Fig. 26—Triple bowl paper element fuel oil filter—C.A.V.

stage operation. In this design the pinion first moves into engagement with the engine flywheel at low speed on a helical thread and at a reduced voltage. The sliding action of the pinion operates a trip switch in the starter which excites an electromagnetic contact switch mounted separately. This cuts out a resistance in the circuit so that the full current flows in the starter windings and full torque is exerted, but this can only take place after the pinion has actually engaged with the flywheel gear ring. With this starter the maximum horsepower available may be from 12 h.p. to 18 h.p., depending on the capacity and type of battery used, and it is suitable for starting multi-cylinder engines of up to at least 60 litres capacity.

The General Electric Company, Ltd.

Marine electrical engineering provides the theme for the exhibits shown by The General Electric Company, Ltd., Magnet House, Kingsway, London, W.C.2. The display includes a 325kW turbo-generator (Fig. 27) for ships' auxiliary supplies. The set, one of twenty being supplied for tankers under construction by the Furness Shipbuilding Company, Ltd., for London Overseas Freighters, is driven by a Fraser and Chalmers 10,000 r.p.m. high-pressure, multi-stage impulse turbine operating at steam conditions of 425 lb per square inch gauge, 725 deg. Fah. total temperature, and vacuum of 28·5in Hg. The turbine is coupled through David Brown double helical reduction gears to a G.E.C. open-canopy, protected, compound-wound marine generator designed to develop 325kW at 220V d.c. when running at 1100 r.p.m. Turbine and generators are mounted on a common bed-plate which incorporates the oil tank. The set is arranged to exhaust into the main condenser. The exhibits also include examples of G.E.C. air-break cubicle switchgear for ships with 440V, three-phase, 60 c/s a.c. supplies. A section of a main switchboard shows the alternator synchronising panels, and part of a typical group starter board includes the starters for steering gear motors. The construction of the cubicles for this range of switchgear is such that no supporting framework is necessary, and the unit parts are so designed that cubicles up to 6ft 6in high can be assembled in standard widths from 1ft 6in to 3ft 6in, and may be installed individually or joined together to form one switchboard. They will accommodate manually or electrically-operated circuit breakers, fused switches, contactors, isolators and instruments. The switchgear is mounted on insulating panels, which in turn are carried on an internal skeleton frame. All parts which might require attention are accessible from the front, but interlocks ensure that they are isolated before the front door can be opened.

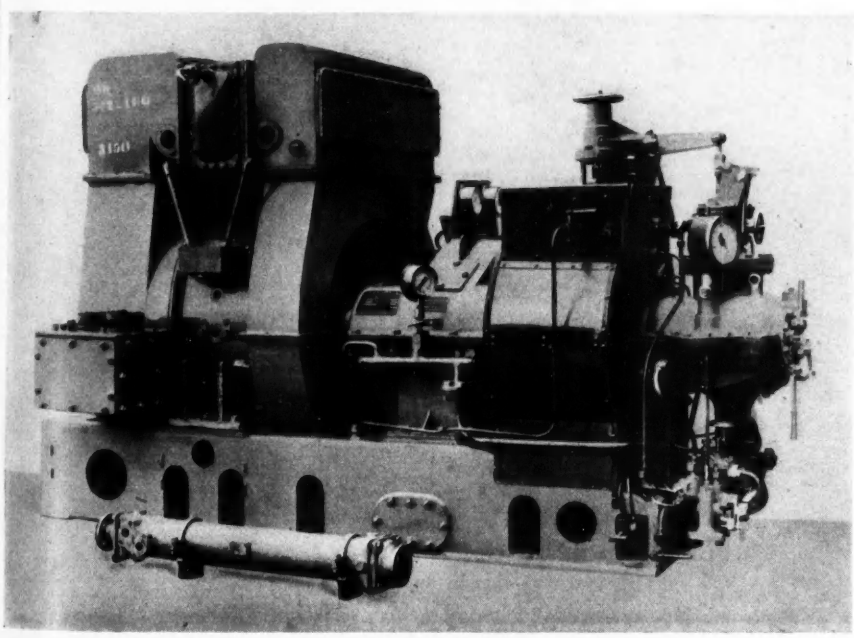

Fig. 27—Geared turbo-generator, 325kW, d.c. for ships' auxiliary supplies—G.E.C.

J. and E. Hall, Ltd.

The refrigeration equipment shown by J. and E. Hall, Ltd., Dartford, Kent, includes the largest of the firm's range of multi-cylinder refrigerating compressors. This vee block compressor, with 7in bore by 5½in stroke cylinders, is a single acting machine with its eight cylinders arranged radially in pairs. It has a capacity of 95·6 tons refrigeration when working under standard conditions of 5 deg. Fah. evaporation and 80 deg. Fah. condensation on "Arcton," or 162 tons refrigeration on ammonia under the same conditions.

One of the compressors is illustrated in Fig. 28. Its pressure-tight cast iron crankcase and cylinder housing is fitted with cast iron renewable cylinder liners. A balanced crankshaft of "Meehanite" cast iron is carried in two steel-backed, white metal-lined, bearings, and is fitted with a rotary packless seal lubricated by the pressure feed system. Two compression rings on the cast iron pistons are fitted with bronze strip inserts which serve to burnish the bores during the initial running of the compressor. Ring plate alloy steel valves are fitted. The seats of the suction valves are integral with a flange at the top of the cylinder liner, and the delivery valves are combined with the spring-loaded safety heads above each cylinder. These safety heads are designed to lift should liquid refrigerant be trapped in the cylinder below. A thin metal disc is fitted in a connection between the suction and delivery gas passages and this disc bursts should an abnormally high delivery pressure occur.

Surrounding the cylinder liners is an annulus from which the suction gas passes through the valves into the cylinders. At the inlet to the annulus is fitted a removable strainer of fine gauze on perforated metal to trap any solid particles. The gas is discharged from the cylinder heads into a separate delivery manifold bolted to the compressor. Forced lubrication is provided to all bearings and the crankshaft seal by a positive action submerged gear pump, driven from the crankshaft. The oil being circulated passes through an externally mounted oil filter provided with isolating valves for servicing. An oil cooler located in the sump operates on refrigerant evaporation. Oil check valves are arranged to prevent oil escaping from the crankcase into the suction gas annulus outside the cylinder liners on starting the compressor, when foaming may occur: oil can, however, return from the annulus through the valves into the crankcase. Should the oil pressure fall below a safe operating level a pressure differential cut-out actuates an electrical circuit which stops the compressor. If required, three out of the four banks of cylinders can be provided with a manual or automatic device permitting a reduction in capacity to approximately 75, 50 or 25 per cent of the full machine capacity.

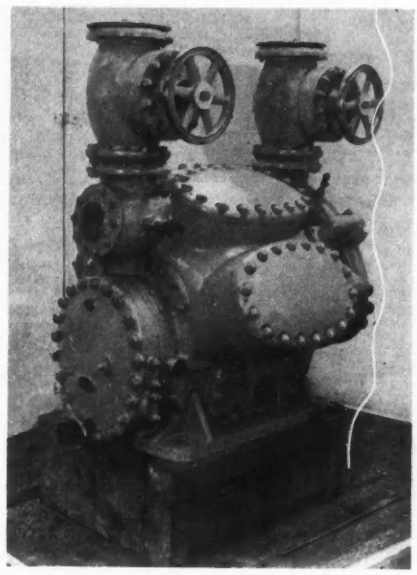

Fig. 28—Eight-cylinder, veeblock, refrigerating compressor—Hall

G. and J. Weir, Ltd.

The central exhibit on the stand of G. and J. Weir, Ltd., of Glasgow, is a large flow model of the Weir closed feed system for ships. In this model there is shown by an ingenious method of circulating air bubbles in a fluid in coloured piping the steam and water flow in the system under various conditions. Five separate conditions can be demonstrated by push-button control: (1) harbour conditions; (2) starting or manœuvring; (3) normal working—closed feed controller making up; (4) operation of closed feed controller when overflowing; (5) emergency stop. The automatic operation of the system under all conditions is demonstrated by the changes in velocity and direction of the fluids, shown by the effective use of coloured lighting. The comprehensive arrangement of units demonstrated includes sea-water evaporating plant and a de-aerator.

The company's very extensive range of auxiliaries for marine and land use is represented by a large seven-throw pump, a direct-acting feed pump and a horizontal geared turbine. The seven-throw recipro-

cating pump, driven through double reduction gearing by a turbine, is similar to one being installed in the new "Empress of Britain" now fitting out. A direct-acting 5in by 7in by 12in boiler feed pump, with a capacity of 1200 to 1450 gallons per hour, is representative of a range of pumps for which the firm has been known for over seventy years. The horizontal geared turbine shown is of the simple impulse type, having one pressure and two velocity stages, and is an example of the turbines designed for driving pumps, fans, sugar mills and other industrial machinery.

Thos. W. Ward, Ltd.

Several examples of the foundry plant made by the Polford Engineering Company, Ltd., of Newcastle upon Tyne, are exhibited upon the stand taken by Thos. W. Ward, Ltd., of Sheffield. This firm makes several designs of mould driers and one of improved construction is shown. This gas-fired drier has a combustion chamber of ¼in steel plate lined with refractory bricks and is fitted with a gas burner designed to take up to 800 cubic feet of gas at 1½in W.G. per hour. Full temperature adjustment is effected by an air regulator giving a maximum temperature of 800 deg. Fah. A flame failure device is linked up with a magnetic cut-out and governor valve to eliminate any chance of unburnt gases being discharged by the dryer into the mould. A blowing fan driven by a 1 h.p. motor has a capacity of 1000 cubic feet of air per minute at 2in W.G., and the hot air discharge can be directed either horizontally or at any angle to the vertical plane.

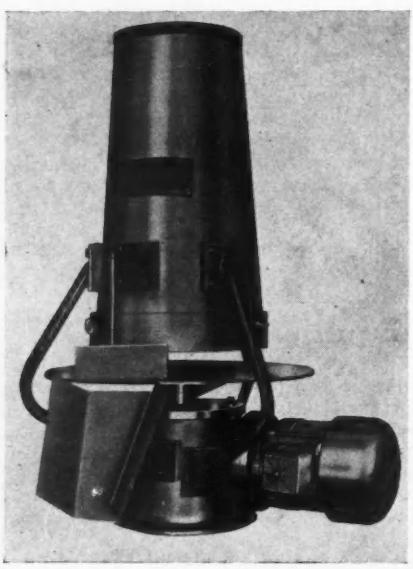

Fig. 29—Portable rotary feeder hopper for granular materials—Ward

Another recent development of this firm is a portable rotary feeder hopper for sand, powders, coal dust or similar materials. This machine (Fig. 29) has a rotating table driven through reduction gearing in the base by a ¾ h.p. flange-mounted motor. The hopper, which has a capacity of 1 to 1½ cwt of material, tapers outwardly from top to bottom so that its outlet is of greater cross-sectional area than its inlet. A skirt round the lower end of the hopper has means of vertical adjustment through thumb screws, so that the gap between the bottom rim and the table can be varied. A spindle supported from a bracket on the hopper carries the ploughing plate used to draw the granular material off the rotating table.

Hayward-Tyler and Co., Ltd.

A vertical, single-stage, centrifugal cargo pump with a vertically split volute casing, shown by Hayward-Tyler and Co., Ltd., Luton, Beds, is specially designed for use on oil tankers. It is usually driven by a steam turbine and has a capacity of 580 to 1600 gallons (water) per hour against a discharge pressure of 140 lb per square inch.

In this pump (Fig. 31) the suction and discharge branches are incorporated in the body, so that the pump casing cover can be removed and the pump dismantled without need for breaking any pipe joints. Two alternative suction branches are provided in the casing. A double-eye entry impeller is overhung on the shaft, which is carried on ball and roller bearings. A downwards extension of the pump shaft through the impeller forms a journal for an emergency sleeve bearing incorporated in the lower part of the casing. This bearing is intended only as a precautionary measure and, as it has a large running clearance of 0·010in, it only comes into effect in the event of shaft deflection. Should the ball and roller bearings carrying the shaft fail this steady bearing protects the impeller and casing wearing rings from damage and the pump shaft from distortion. A mechanical seal is fitted in the stuffing-box and a drain-hole in the casing allows any liquid leaking through this seal to run to the bilges.

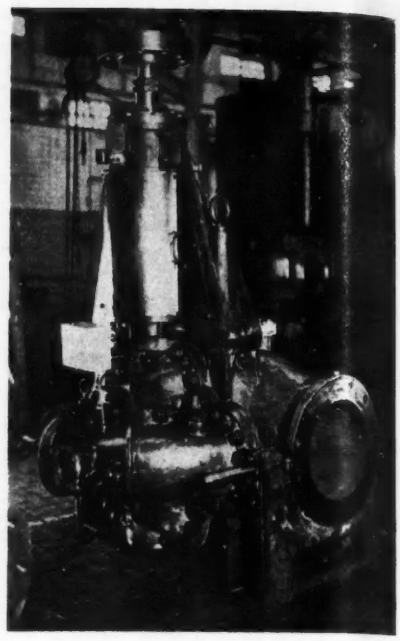

Fig. 31—Vertical centrifugal cargo pump with a capacity of 1600 tons (sea-water) per hour—Hayward-Tyler

Also to be seen on this firm's stand is the 1000 h.p., 1485 r.p.m. "Electromersible" liquid-filled dynamometer motor, illustrated in Fig. 30. This motor is designed for use as a swinging frame dynamometer for testing horizontal pumps, and for this purpose it is mounted on trunnion bearings and fitted with a weighing gear and a speed indicator. It is also suitable for vertical mounting for driving vertical pumps on test and for this application the efficiency of the motor is determined while on the horizontal set-up.

The motor is of the wet stator design as normally used by the firm for its submersible motors. The winding cables are insulated with a special form of PVC and the whole of the interior is filled with water which cools the windings and lubricates the bearings. Winding leads brought out of the shell through pressure-tight cable seals are joined to the external supply cables in water-tight phase junction boxes. These junction boxes are equally spaced around the circumference of the motor to balance it when swinging in the trunnion bearings. The rotor is laminated with double squirrel-cage windings.

Michell tilting pad journal bearings are fitted and a tilting pad double-sided thrust bearing which takes the weight of the rotor when running vertically serves to locate it when running horizontally. The whole of the motor is contained in a water-tight shell, the driving shaft and tachometer drive being

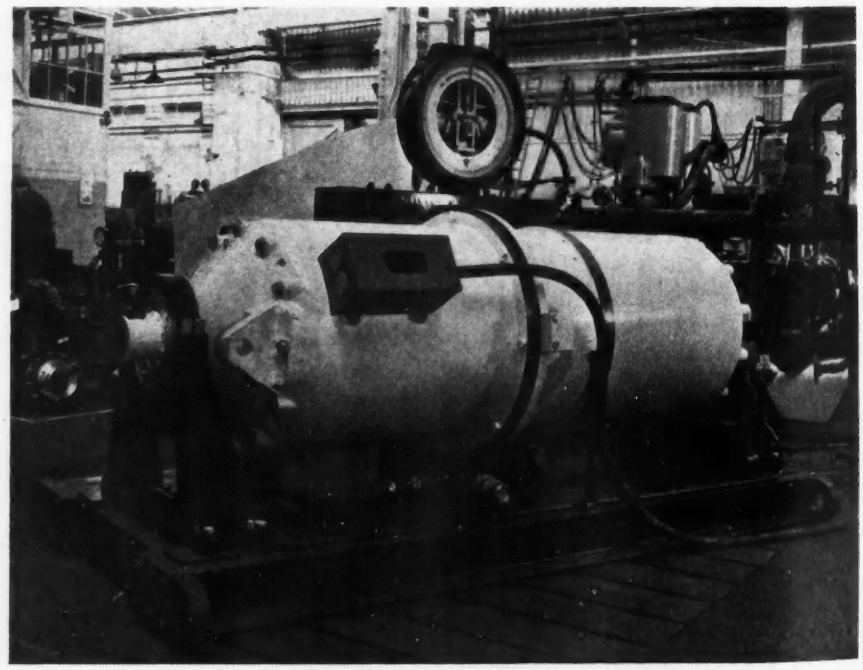

Fig. 30—"Electromersible" 1000 h.p. liquid-filled dynamometer motor—Hayward-Tyler

brought out through water-tight mechanical seals.

The water within the motor is circulated through the motor and through an external cooler by an impeller mounted on the rotor shaft. This circulation is on a closed circuit and the water is inhibited to prevent corrosion of steel parts. A header tank provides a small static head on this system. External cooling water is supplied to the cooler by a small motor-driven centrifugal pump which takes water from the test bed well and returns it to the well from the cooler.

The output of the dynamometer is measured mechanically on a 2000 lb weighing gear (manufactured by Ashworth Ross and Co., Ltd.), actuated by a short arm on the motor case and having the dial marked in 4 lb divisions. The gear has a reversing linkage and can thus be used for pumps of either direction of rotation. The motor is also designed for either direction of rotation. The speed is recorded on a dial indicator by a high precision speed indicating gear made by Everett Edgcumbe and Co., Ltd. It comprises a tacho-generator driven by direct coupling from the motor shaft, an amplifier and the indicator, which can also be used as a precision frequency meter.

The connections to the motor supply leads and the flow and return water connections, are all arranged to be extremely flexible so as not to affect the weighing gear readings. As a result of this design the makers state that the 7½-ton motor responds to less than 5 lb change of loading.

Self-Changing Gears, Ltd.

The equipment shown on the stand of Self-Changing Gears, Ltd., Lythalls Lane, Coventry, includes an "R14" gearbox for railcars. A large number of these boxes are being supplied to British Railways under the diesel railcar programme and they incorporate compound epicyclic, four-speed gearing and pressure lubrication and are fitted with balanced, self-adjusting band brakes. These band brakes are air-operated through electro-pneumatic valves which enable eight gearboxes to be operated simultaneously from the driving position.

A section through one of the gearboxes is illustrated in Fig. 32. In the box each indirect gear has its own balanced brake, which consists of two concentric bands, one within the other. With the form of wrapping brake used, the friction of the brakes on the drums tends to increase their grip. The operation of the compound epicyclic type running gear is best understood by regarding the first speed gear train as being the basic train. The sunwheel of this train is splined to the input shaft and meshes with the planets, which are carried on a flange on the output shaft. The planets in turn mesh with the first speed annulus.

When the first speed annulus is held stationary by its brake and the input shaft is driven the planets are caused to roll round inside the annulus, carrying with them the output shaft at a speed determined by the reduction ratio of this gear train. The other epicyclic trains cause the annulus of the basic train to rotate at certain fixed increments of input speed, which has the effect of producing the other ratios.

Movement of the driver's control switch energises an electro-pneumatic valve which directs air to the appropriate brake cylinder. This raises a piston and through a toggle mechanism applies the brake. The pistons are of varying size according to the torque reaction which each brake has to sustain. The top speed clutch locks together two of the running gear elements and causes all the gearing to rotate as one unit. Thus, in top gear, no wear occurs in the intermediate gear trains as the drive is transmitted direct from the input to the output ends of a box.

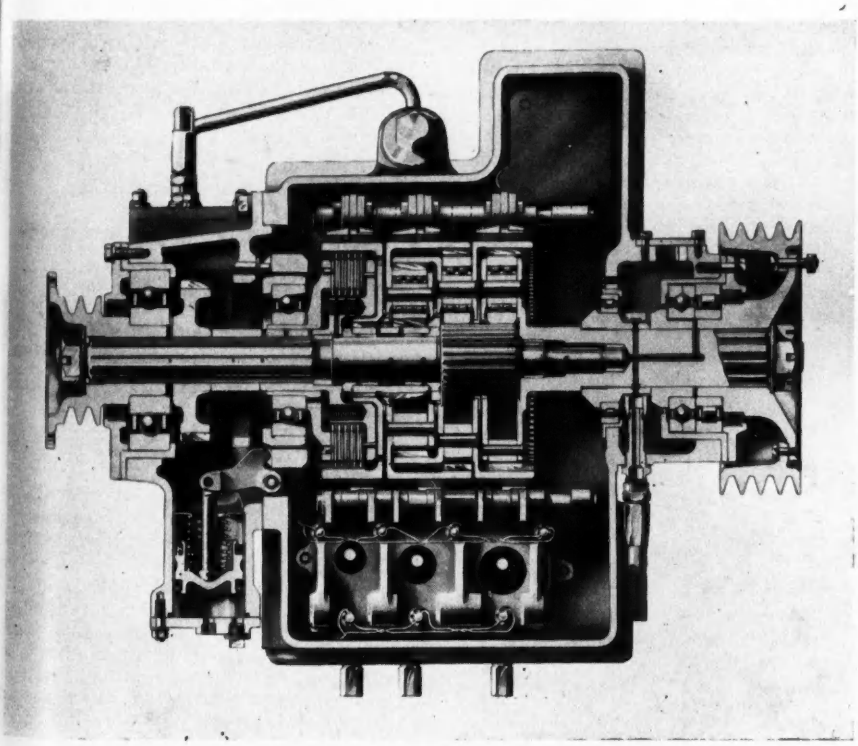

Fig. 32—Mechanism of an "R14" diesel railcar gearbox—Self-Changing Gears

Belliss and Morcom, Ltd.

An air compressor with a capacity of 650 cubic feet per minute at 100 lb per square inch exhibited by Belliss and Morcom, Ltd., Ledsam Street, Birmingham, 16, is typical of the machines now being made by the firm in sizes up to 5000 cubic feet per minute. In this compressor (Fig. 33) the inlet and discharge valves are arranged on opposite sides of the cylinder, so that the corresponding passages are entirely separate and any preheating of the cool incoming air is prevented. The air passages are entirely formed in the cylinder and have been carefully designed to give a streamlined flow, and this, in conjunction with the one-way movement of the air through the cylinder, results in minimum pressure loss.

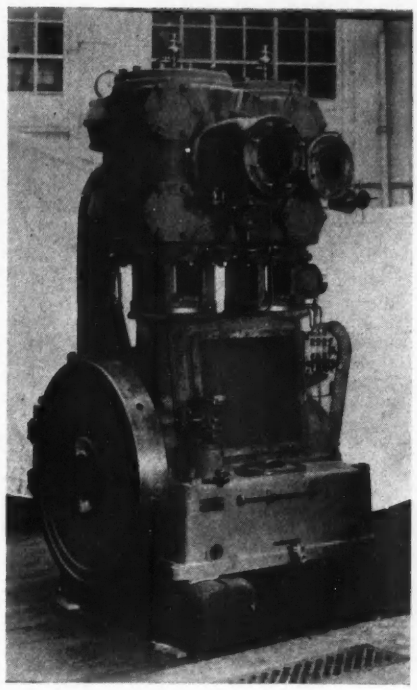

Fig. 33—Air compressor with a capacity of 650 cubic foot per minute at 100 lb per square inch—Belliss and Morcom

The arrangement of valves in the cylinder barrel enables the whole of the surfaces exposed to air compression to be effectively cooled and adequate cooling can also be arranged all round the valve pockets. This combination of low air pressure loss, small clearance volumes and effective cooling results in high efficiency and low power input.

The new design of intercooler is arranged with a single air pass and six or more water passes, and the contraflow arrangement ensures a minimum air drop and effectively reduces the volume of air before entering the second-stage cylinder. The makers point out that even with the comparatively small air compressor exhibited, the horse-power per 100 cubic feet of free air per minute to 100 lb per square inch at sea level is as low as 18·5.

Special attention has been given to ease of maintenance in these new compressors, and it is stated that a valve can be removed and replaced in less than five minutes. The intercooler tubes are conveniently divided into small self-contained tube stacks which can be withdrawn quickly and easily without interfering with the main air pipes.

In Fig. 34 we illustrate one of the steam turbine plants specially designed by the firm for instructional use in colleges and technical schools. It enables a variety of tests to be carried out to determine the effect of different types and combinations of blading and of changes in speed and steam conditions.

One, two or three Rateau stages may be used with two kinds of nozzles, either as fractional or complete circumferential arcs. Alternatively, the turbine can be arranged with two or three Curtis rows or combinations of Curtis and Rateau. Any back

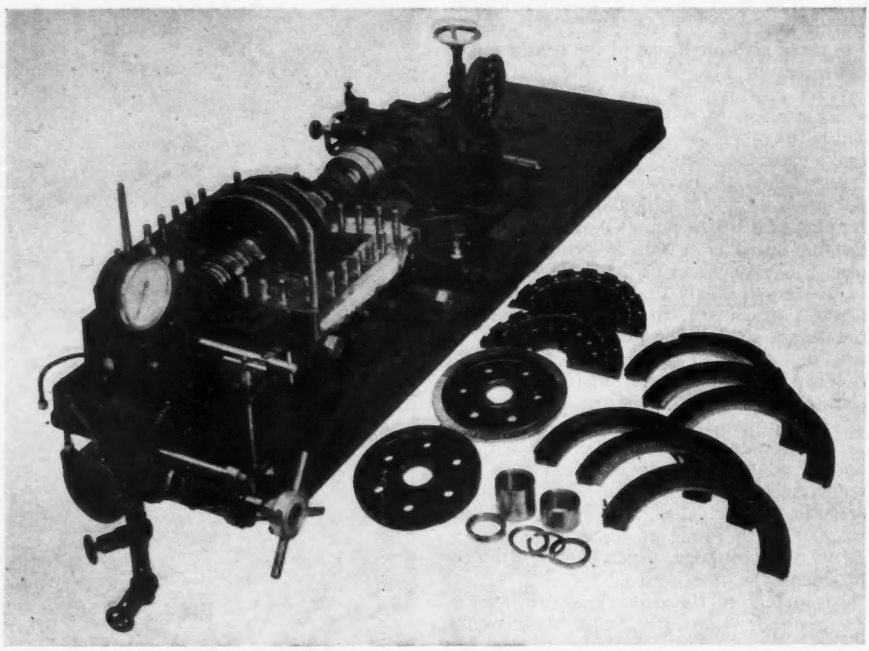

Fig. 34—Steam turbine plant for educational establishments—Belliss and Morcom

pressure approximately up to the supply pressure may be applied, so that the energy drop over a wide range can be investigated.

The installation includes a condensing plant with auxiliaries. The load is absorbed by a Heenan and Froude direct-coupled water brake, measurement being by a balance. With this design of turbine a wide series of tests may be made with a steam supply of 1000 lb to 1500 lb per hour, but the makers point out that up to 3000 lb per hour is preferable.

There is shown upon this stand a marine auxiliary generating set comprising a two-crank, compound engine coupled to a d.c. generator, the complete unit being mounted on a cast iron combination base-plate. The engine has a standard output of 150 b.h.p. and 10 per cent overload for two hours at 525 to 600 r.p.m., when supplied with steam at 120 lb per square inch at the throttle valve and exhausting to atmosphere.

Hopkinsons, Ltd.

The exhibits of Hopkinsons, Ltd., Huddersfield, consist principally of boiler mountings, valves and associated equipment for both land and marine installations, and include a range of standard valves for pressures up to 2000 lb per square inch.

The water level television system demonstrated by the firm for the first time at an exhibition is designed to reproduce, instantaneously and with complete accuracy, the appearance of remotely situated water level indicators on large boilers. The equipment consists of a scanning unit and amplifier, usually located together, and a display unit which may be located remote from the other units, such as on a control panel. This system is designed for use with the firm's prismatic water level indicator and does not need any external illumination. The special illuminator on the water gauge is so arranged that the steam space appears as a clear light and the water as a dark column. A schematic diagram of the system is reproduced in Fig. 35.

The scanning unit is so placed as to permit the light from the gauge to pass through a camera lens, plate slot and scanning disc and on to a light-sensitive cell. As the synchronous motor-driven scanning disc revolves, each of its spiral slots moves downwards in a vertical plane across the narrow vertical slot in the plate; thus, at any moment these spiral slots and the plate slot expose a small rectangular aperture through which any light emitted from the gauge may pass via the lens. The light thus received impinges on the grid of the photo-electric multiplier which transforms the light impulses into electrical ones. These, in turn, are further amplified through the amplifier unit and pass to the cathode-ray tube of the display unit for transformation back to light impulses on the screen.

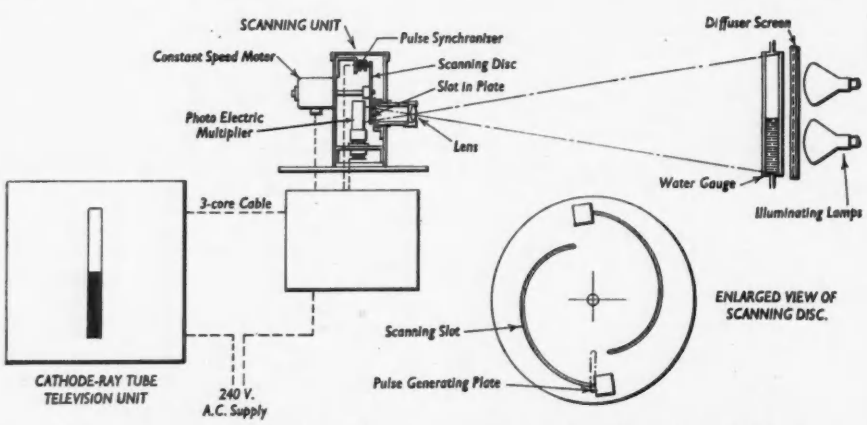

Fig. 35—Schematic diagram of operation of remote water level television system—Hopkinsons

A manœuvring valve incorporating an integral balance valve for marine installations is designed for easy operation and with a sensitive control of steam flow during the early stages of opening. When the manœuvring valve is closed, the balance valve is also closed, and the piston on the spindle of the main valve is in equilibrium owing to steam leakage past the piston rings. Steam pressure on the top of the valve head offers considerable resistance to the opening of the valve by the handwheel. Before opening the manœuvring valve, the balance valve is first opened, and this allows steam to pass from the top side of the piston to the outlet side of the valve, thus putting the manœuvring valve head and piston assembly almost in equilibrium. The manœuvring valve can then be operated as required with only the negligible amount of effort required to overcome stuffing-box friction.

A parallel slide steam stop valve, with a steam cylinder for emergency closing by remote control, is made by the firm for marine service. In an emergency the leak-off valve of the steam cylinder is opened, and this exhausts the underside of the piston to atmosphere, the steam pressure in the valve body then forces the piston assembly down until the valve is completely closed.

Tuscan Engineering Company, Ltd.

An example of a recently developed range of self-exciting self-regulating alternators (Fig. 36) is being shown for the first time by the Tuscan Engineering Company, Ltd., Bridgend, Glamorgan. These machines have rotating armatures and are stated to be inherently self-regulating to within $\pm 2\frac{1}{2}$ per cent of rated voltage under normal operating conditions at unity power factor.

These machines are designed to form part of small power plants or house lighting plants. Single-phase outputs of 0·25kVA to 2·0kVA are obtainable from the present range of

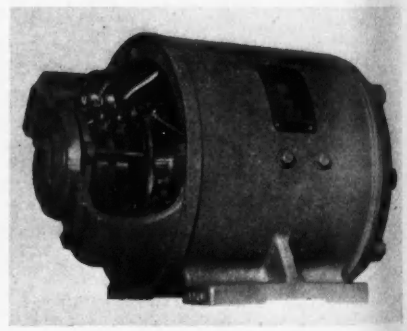

Fig. 36—Self-excited self-regulating alternator with covers removed to show brushgear—Tuscan

machines, at any standard voltage, at 50 or 60 c/s. The alternators are made in two forms: foot mounted (Fig. 36) for direct coupling or belt drive, or with a hollow shaft and single bearing for mounting on the engine crankcase. In the accompanying illustration the machine is depicted without its protective covers, showing the layout of the brush gear.

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